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UNION OF SOUTH AFRICA

DEPARTMENT OF COMMERCE AND INDUSTRIES

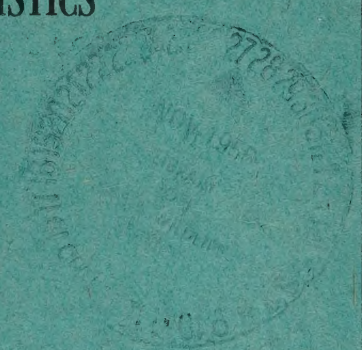
DIVISION OF FISHERIES

INVESTIGATIONAL REPORT No. 21

THE CAPE FUR SEAL

Arctocephalus pusillus (Schreber)

ITS GENERAL CHARACTERISTICS AND MOULT



BY

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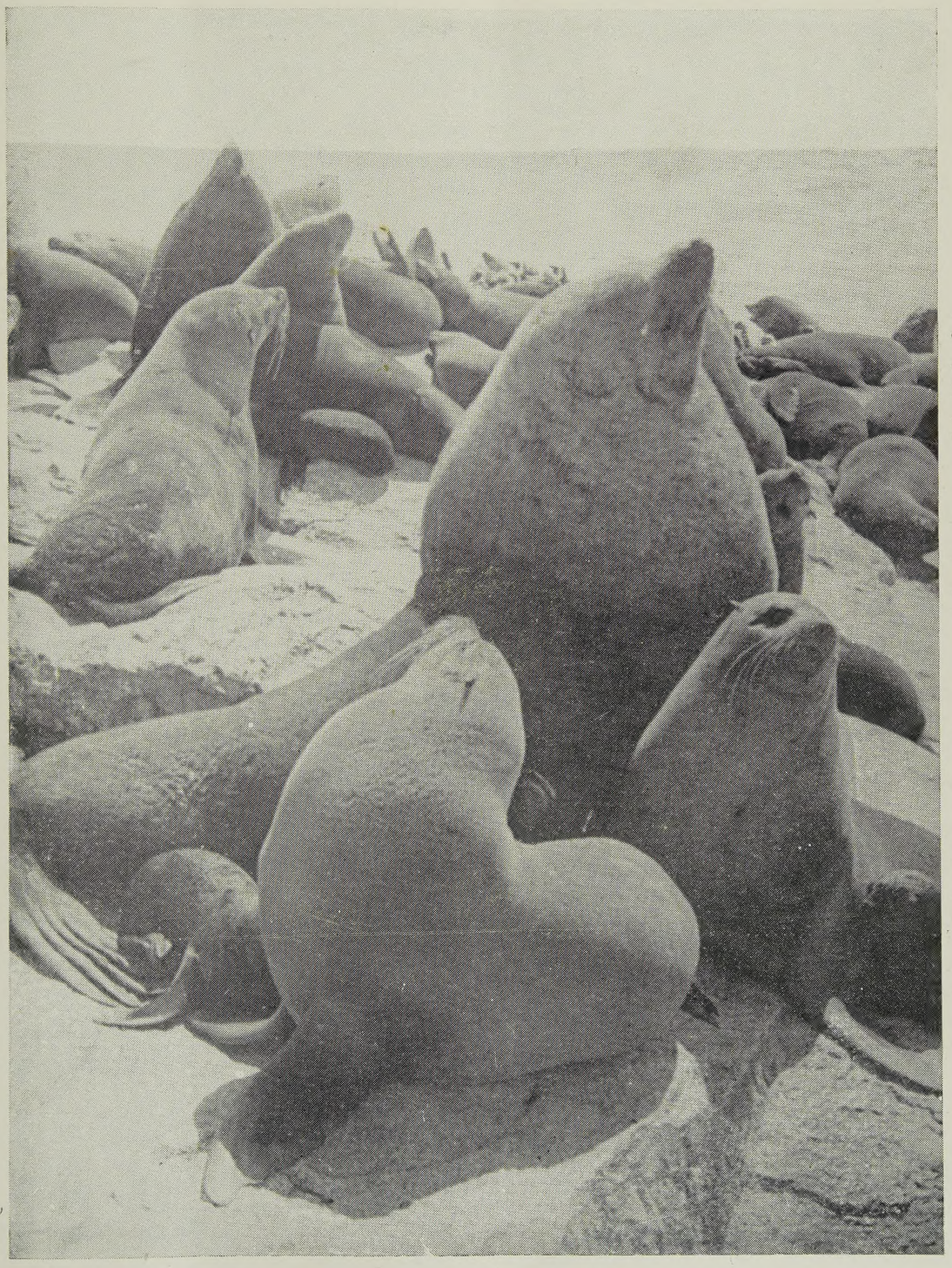

A small harem group consisting of a bull and two cows with pups.

1189—2

CONTENTS.

PAGE.

1. Summary 5
2. Introduction 5
3. Classification 5
4. Distribution 7
5. Material and methods 8
6. Physical characteristics 9
   (*a*) Age grouping—
      (i) Marking 9
      (ii) Date of capture 10
      (iii) Coat colours 10
      (iv) Vibrissae 10
      (v) External measurements 11
      (vi) Reproductive status 11
      (vii) Dentition 12
      (viii) Degree of ossification 12
      (ix) Cranial characters 12
   (*b*) Group characteristics—
      (i) The Black Pup 15
      (ii) The Yearling 17
      (iii) The Second-Year 19
      (iv) Older Groups 21
7. Moult 27
   (i) Moult in Black Pups 28
   (ii) Moult in Yearlings 29
   (iii) Moult in Second-Years 30
   (iv) Moult in Adults 30
   (v) Unseasonal Pups 31
8. Mortality 31
9. Acknowledgments 32
10. Literature cited 32

1. SUMMARY.

(1) The Cape fur seal *Arctocephalus pusillus* (Schreber) forms the basis of a valuable industry operating biannually off the coast of South Africa. Research into the biology of this seal is reviewed.

(2) Cape fur seals belong to a family of eared seals, to a species that is furred. The specific name *pusillus* depends upon an old description which, however, failed to designate the locality where the seals were commonly found. It is believed nevertheless that the type-specimen came from the Cape. As the name is universally applied by present-day systematists, no departure is made from accepted usage.

(3) Confined to the coasts of the Cape Province and South West Africa, the fur seal frequents islands close inshore and may even be found on parts of the deserted mainland.

(4) Material for study was collected mostly at a single rookery (Sinclair Island), but has been supplemented by animals caught on other islands and at sea.

(5) Age-grouping, important in understanding the status of the animals, depends upon a relative system of grading individuals by means of the skull (rate of closure of sutures), external measurements and reproductive condition. There is as yet no means of ageing them satisfactorily. Eleven male and twelve female groups are identified, some with actual annual groups but the majority by relative means (suture grouping). Graded physical characters are described, emphasis being placed on dimorphism brought about by sex and age.

(6) All animals moult each year in the summer. Pups lose their black coats after four months, changing these for the olive-grey yearling coats which are lost some twelve months later. The guard hair is shed gradually, replacement being complete after five to seven weeks. The fresh coat contrasts with the faded winter one.

(7) The fur seal has few enemies. Sharks and killer whales take toll of the seals but the extent of their predation is unknown. Climate topography, the vicissitudes of an aquatic life and the hazards experienced on crowded islands, are among the factors affecting the safety of the animals. Regular sealing operations crop all herds heavily.

2. INTRODUCTION.

The Cape fur seal *Arctocephalus pusillus* (Schreber) has been exploited for over three hundred years and guarded reports of man's interest in it have appeared from time to time. Since the start of research in 1946, certain aspects have been investigated but there is no comprehensive summary of the natural history of this fur seal. During the present study research was affected by the usual limitations of a single observer and it was not possible, for instance, to take simultaneous observations at different rookeries. There were many interruptions during the work and careful consideration had to be given to the commercial utilisation of the animals. Thus the special demands of inshore sealing during the summer and winter, that is, repeated interference of the pup class during the same year, gave priority to behaviour studies of the herd. These were pursued along more specific lines later. The rookery rather than the open sea is the focus of sealing operations and it was the former that held attention at first. In 1949 three mimeographed reports (Rand, 1949 a, b, c) for limited circulation preceded a more detailed account of the reproductive behaviour of the female fur seal (Rand, 1955 a). Off-shore movements were recently studied in conjunction with feeding habits. Furthermore it is hoped that the application of techniques learned during a visit to the Pribilof Islands in 1953 will give a better understanding of fur seal problems on the Cape coast. In this respect a start was made by tagging pups on Seal Island (False Bay) with the object of gaining information about their life-history, rate of growth and other data concerning the bionomics of the herd in that area. Tagging will be extended to other rookeries later.

Before we can fully understand such a conveniently exploitable resource as a fur seal population, it is necessary to analyse the qualities of individual animals. The present account is the first of a series in which it is proposed to deal with the general characteristics of the Cape fur seal, its behaviour on land and its present and past exploitation.

3. CLASSIFICATION.

Pinnipedes are classified into three large families, the *Odobaenidae* or walruses of the Arctic regions, the *Phocidae* or true seals and the *Otariidae* or eared seals. Cape fur seals are the otariids of the South African coast. Occasionally elephant seals and leopard seals, both belonging to the *Phocidae*

come ashore and are captured by sealers or may intrigue visitors on the lonely beaches of the Cape coast. Unconfirmed reports exist of the presence of solitary sea lions of the family *Otariidae* on the South West African coast. The walrus, not found in the southern hemisphere, has long ivory tusks which sets it in a family quite apart from the other seals. The proper identification of the other two families encountered on the South African coast is of great interest. They may be separated by examining the following characteristics (partly after Howell, 1928, and Bobrinskii, 1944):—

Otariidae.—Small external ear. Fore limbs only slightly shorter than hind limbs. Both fore and hind limbs can be turned forward. The fore limbs are used extensively in a plantigrade position for terrestrial locomotion. Underside of all four flippers is hairless. Claws on hind flippers are small and situated some distance from the outer edge. Testes are scrotal in the adult. Skull with supraorbital processes and alisphenoid canal. Tympanic bullae are small and irregular. Nasal bones do not form a wedge between the frontal bones.

Phocidae.—No external ear. Fore limbs are small and much shorter than the hind limbs which latter cannot be turned forward. The fore limbs are not used primarily in movement on land. Fore and hind flippers are covered with hair on both sides. Claws of the fore flippers are large. Claws of the hind flippers may be well-developed and lie at the edge of the limb. Testes are abdominal in the adult. Skull without a supraorbital process or alisphenoid canal. Tympanic bullae are large and pear-shaped. Nasal bones form a wedge between the frontals.

According to a recent taxonomic report (Sivertsen, 1954) there are six genera (thirteen species) in the *Otariidae*. These genera can be separated into two broad groups (hair and fur seals) having the following characteristics:—

A.—Hardly any under-fur. Hair of the fore flipper covers much of the wrist. Nasal bones are not sharp-pointed in the front. The sagittal crest is long and high. Skull length of the adult male varies from 292–386 mm. except in *Zalophus* (264–292 mm). Four genera, *Eumetopias*, *Otaria*, *Zalophus* and *Nepohoca**. The sea lions of the American and Australian coasts.

B.—Thick under-fur. Hair on the fore flipper extends only up to the wrist which is hairless. Nasal bones are narrow in the middle and have sharp points in front. The sagittal crest is small and restricted to the rear of the skull. Two genera, *Callorhinus* and *Arctocephalus*. The fur seals of the North Pacific and Southern Hemisphere respectively.

Many species have been included in the genus *Arctocephalus* and a considerable amount of work is yet needed to establish which of these are valid. From a scrutiny of previous accounts of this genus (Peters, 1877; Heller, 1904; Jones, 1925; Scott and Lord, 1926; Bertram, 1940) it appears that the following species have been identified: *A. australis*, *A. doriferus*, *A. forsteri*, *A. tasmanicus*, *A. townsendi*, *A. galapagoensis*, *A. gazella*, *A. pusillus* and *A. philippi*. King (1954) shows that *A. townsendi* is the same as *A. philippi* and that *A. galapagoensis* should be included in the synonymy of *A. australis*. Sivertsen (1953) recently recognised five species, *A. galapagoensis*, *A. australis*, *A. pusillus*, *A. gazella* and *A. forsteri* and thinks that *A. doriferus* and *A. tasmanicus* should be included in the species *A. forsteri*. Sivertsen (1954) says that *A. townsendi* and *A. philippi* should be referred to the genus *Arctophoca*. King (in ms.) says that the skulls of *A. doriferus* and *A. forsteri* in the British Museum collection are distinctly different.

Plate I shows the distribution of the various species, which may also be summarised as follows:—

(1) *A. australis*.—Southern fur seal. South American coast from Uruguay to the Galapagos Islands, Falkland Islands, South Georgia.
(2) *A. pusillus*.—Cape fur seal. South and South West African coasts.
(3) *A. gazella*.—Kerguelen fur seal. Bouvet, Marion and Kerguelen Islands.
(4) *A. forsteri*.—New Zealand fur seal. New Zealand.
(5) *A. doriferus*.—Australian fur seal. South coast of Australia.
(6) *A. tasmanicus*.—Tasmanian fur seal. Tasmania.
(7) *A. philippi*.—Chilean fur seal. Juan Fernandez, Mas a Fuera, Guadalupe and Farallone Islands.

There is some doubt about the locality of the type specimen of the Cape fur seal, and it is probably for this reason that there has been some confusion between the two names *A. pusillus* (Schreber) and *A. antarcticus* (Thunberg). A short account of the historical background of these two names will show that *A. pusillus* is more acceptable.

* Note.—Miss King (in ms.) considers that *Phocarctos hookeri* should be included among the hair seals.

In 1776 Schreber described a small eared seal previously mentioned and illustrated by Buffon (1765) who called it " le petit phoque noir " and claimed that it came from " des Indes ". In reproducing Buffon's plate and description, Schreber (1776) labelled his seal " *Phoca pusilla* " and gave it a more definite locality as follows: " Diese Gattung findet sich in den levantischen und nach dem Herr Grasen von Buffon, im Indischen Meer ". Buffon (1785) in a further description of his small seal says that he thinks there is a second species of " sea bear " of small size and that M. de Pages had also seen it at the Cape of Good Hope (False Bay), where the largest adults were only four feet long and most were only about two feet long. It appears that this is the nearest one can get to the locality of the type specimen of *A. pusillus*. Thunberg (1811) gave the name *Phoca antarctica* to a seal from the Cape of Good Hope but all he said was that it inhabited the southern seas. This cannot be taken as a valid description and so *P. antarctica* must remain a *nomen nudum*, while *A. pusillus* stands as the most correct name for the Cape fur seal.

4. DISTRIBUTION.

The Cape fur seal is a coastal species with a rather limited range. Owing to its peculiar breeding habits, distant migrations are not performed and as far as is known the bulk of the population is confined to a comparatively short distance from the land (100 miles or so). Breeding places are spread round the South and South West African coasts from Cape Cross in the north to Algoa Bay in the east. Many years ago the species was thought to extend far into the Atlantic to St. Helena Island (Mortensen, 1933), but this low latitude distribution has received no further confirmation (Fraser, 1935). In 1830 Lesson mentioned a seal *Otaria forsteri* (sic) on Tristan da Cunha. Elliot (1953) considers this to be *A. pusillus* and describes how the population is increasing on Nightingale Island. Sivertson (1954) thinks that it may be either *A. gazella* or *A. pusillus*, but a specimen obtained by the writer from Gough Island in 1952 was not similar to the Cape fur seal and appeared to be related to *A. gazella*. It is improbable that the Cape fur seal circulated as far west as the Tristan group of islands within historical times.

The L-shaped breeding range of *A. pusillus* covers thirteen degrees of both latitude and longitude (see Plate I). Stretching from 21° 14′S to 34° 57′S latititude and from 13° 53′E to 26° 16′E longitude, it impinges upon two oceans. Within this area the seals breed on fifteen rocky islands extending round the Cape and South West African coasts. There are sizable rookeries at various points on the mainland. The herds congregate on Hollamsbird Island, Anischab, Staple and Boat Bay Rocks near Luderitzbucht, Long Island, Albatross Rock, Sinclair Island, Elephant Rock, Jacob's Rock, Robbesteen (near the mainland opposite Robben Island), Quoin Rock, Geyser Island (adjacent to Dyer Island) and three islets in False Bay, Mossel Bay and Algoa Bay respectively. Numbers of seals may be seen breeding in summer on the mainland at Cape Cross, in an area opposite the Long Islands (between Wolf and Atlas Bays), near Black Rock*, and are said to be on part of the isolated coast of the north-west Cape near Hondeklip Bay*. In addition to these established hauling-out places seals occur on other small rocks such as Duikerklip (Hout Bay), Stompneus Point, Roastbeef Island and small rocks near Luderitzbucht. The topography of these rookeries will be discussed in detail in another report. Their position on the coast is shown in Plate I which includes isotherms of the waters in the vicinity of the rookeries (Clowes, 1950). The present-day herds are also shown on this plate by means of closed circles, the deserted hauling grounds by means of open circles. While any relationship between habitat and temperature is obscured by the paucity and location of suitable rocks or islets round the whole coast, it is significant that the species does not extend far northwards into the warm waters of the east coast. Equipped with a thick layer of subcutaneous fat and a fur pelt, the seals are adapted for cold water. As far as is known the influence of the Benguela current (temperature 10° to 20° C.) is felt over most of their range.

The home of *A. pusillus* lies 900 miles north or the known range of the smaller Marion Island fur seal *A. gazella*, and 1,500 miles east of the fur seals of Gough and Nightingale Islands. There is no known overlapping of the geographical distribution of these three fur seal populations, although the fur seals from Marion and Gough Islands have both been identified with *A. gazella*. Elephant seals *Mirounga leonina*, and leopard seals *Hydrurga leptonyx*, are the only other pinnipedes straying within the home range of *A. pusillus*. In 1953 a cow elephant seal and newborn pup were discovered on the Bredasdorp coast but this species has never been known to breed there. They are stragglers that have drifted up from the south or west. An unconfirmed report of a sea lion (*Otaria*) came from Possession Island, South West Africa, some years ago.

* Note.—Not personally visited by the writer.

The location of the southern fur seals is mapped diagrammatically in Plate II, which is based partly on the findings of Sivertsen (1954) and King (1954). The figure does not define the pelagic distribution of the various species but is intended to emphasise the whereabouts of their breeding grounds.

5. MATERIAL AND METHODS.

Several weeks were spent at various rookeries in the collection of material from the summer sealing operations. In addition, observations on seals were made at other times of the year. In all, more than seventeen months were spent on Sinclair Island (1947/48), shorter periods on Dyer Island, Seal Island (False Bay) and Hollamsbird Island (1951). These observations were supplemented by special visits to Marion Island (1951/52), Tristan da Cunha and the Pribilof Islands (Alaska) in 1953, the purpose of the last overseas trip being the appraisal of research and management of *Callorhinus ursinus*, the Northern fur seal. Pelagic investigations into the feeding habits of seals on the Cape coast have been conducted since the middle of 1954.

When remaining for a long time at a rookery, it was customary to work from " observation hides ". Where possible these were built before the summer, two sites being chosen so that if access to one was blocked by the expanding herd, an alternative could be used. The platforms and catwalks on St. Paul Island (Pribilofs) greatly facilitate study of *C. ursinus* (Kenyon and Scheffer, 1954, fig. 4). Their construction both for research and management could be copied with profit on many of the South African islands.

Fur seal research depends upon a supply of adequately marked animals. Only in this way can individual records present dependable data about specific animals, and if numerous enough, about the herd as a whole. Random hunting at sea receives a big fillip if marked animals are captured. Their presence in a particular place can be interpreted in relation to previous handling. On land, marked animals are vital for understanding relationships within the herd. Among the identification marks used at first paint was of limited value except as a temporary expedient for short-term work (Rand, 1950 a). Bulls can be marked by daubing on the head with a paint-umpregnated swab fixed to the end of a bamboo pole. Bartholomew and Hoel (1953) found this method particularly useful for analysing the structure of harems on St. Paul Island. Tagging by means of monel metal tags was successful with *C. ursinus* pups (Scheffer, 1950 a), and was recently applied to Cape fur seal pups on Seal Island (False Bay), February being a suitable month for the work. Branding gives lasting marks effective for distant (binocular) recognition. Originally it was not intended that brand marks should be used to give data about age, as it was believed that the marks would soon be obliterated by growth of the outer coat. This was not the case and consecutive numbers branded on the rump have proved legible over seven years and their use is merited in all instances where practical difficulties of handling the animals can be overcome. Certain individuals have peculiar scars and idiosyncraceis which sometimes help to make possible the recognition of these particular animals later on. In general, however, it is better to mark individuals either by branding or tagging in order to make subsequent identification certain.

The summer sealing season usually commenced in late October and it ended during the first week of December. The bulk of the old male specimens was obtained during this period. It was customary to select and mark bulls shot by the sealers and complete a superficial examination of these animals before the flayers cleared the rock of all carcasses. Other biological work, however, was severely curtailed during these operations because shooting continued throughout the day. Unfortunately the tempo of sealing, intolerant of delay, impeded rather than assisted scientific work and it was necessary to augment specimens from the sealing catch by others taken during less disturbed months. Furthermore, while animals with known life histories were preferred, most specimens were accumulated at random. They were shot with a 0·22 rifle, this calibre being effective if the bullet entered the cervical vertebrae. At sea the seals were killed by means of a 12 gauge shot-gun using special SSG shot or with a Kongsberg M52 harpoon-gun. Over two hundred females were collected at Sinclair Island. Some were found dead on the rookery but most were specially taken for a study of the reproductive cycle (Rand, 1955 a). A somewhat similar number of males was shot at the same time. Detailed autopsy provided data about the age, growth, sexual status and physical condition of the animals. These records were supplemented by and compared with data from seals killed at other rookeries (Seal Island, Dyer Island). A detailed histological examination of the material (ovaries and testes) was made by means

of haematoxylin and eosin-stained sections, some of which were cut at the Onderstepoort Veterinary Laboratory.

The skull was measured in the following manner: the *skull length* is taken from the upper surface of the foramem magnum (not from the condyles) to the anterior end of the premaxilla; the *zygomatic width* is the greatest breadth across the zygomatic arches; the snout or *hamulo-premaxilla length* is measured from the anterior surface of the premaxilla to the tip of the pterygoid (hamula) process.

Measurements of the body and flippers were made by means of a steel tape. The *total length* was taken with the animal lying on its belly and is the length from tip of nose to tip of tail along the back of the animal. The *girth* is the circumference of the body behind the fore flippers. The *flipper length* is the distance from the tip of the digit to the axilla when the flipper is held at right angles to the body.

Colour descriptions of the coat, when stated in capital letters, follow the nomenclature suggested by Ridgway (1912). Colour discriminations were made at the time and place of capture of the seals.

6. PHYSICAL CHARACTERISTICS.

Casual descriptions, mostly of historical interest only, have outlined the general appearance of the Cape fur seal. This seal was well-known during the last century to French zoologists such as de Pages (1782), Desmarest (1820) and Lesson (1830) all of whom have given excellent descriptions of the habits of seals encountered at the Cape of Good Hope. The skull figured in many taxonomic disputes during the last century, two comparative accounts being of interest namely, Turner (1888) and Allen (1870). More recently, cranial characters of the family *Otariidae* have been compared by Sivertsen (1954) who gives many details about the *A. pusillus* skull.

A herd of Cape fur seals is a heterogeneous group of animals and presents great variations in appearance. This is perhaps less striking in the herd itself where the many gradations between individual and class are continuous but isolated animals seem very dissimilar. In describing an individual or group such as a herd on a particular island, it is necessary to consider the variations brought about by progressive growth. Unfortunately no system of absolute ageing has yet been found for *A. pusillus*, and the subsequent account of graded physical characters depends entirely upon relative ageing.

(a) Age Grouping.

Cape fur seals thrive in captivity. From old records of the London Zoological Gardens, it appears that they reach a ripe age under sheltered conditions. One female attained an age of twelve years six months, another female twenty years (Flower, 1931). There is no description of the growth and appearance of these animals of known age.

In the field, sealers estimate the age of seals up to the fourth or fifth year with some accuracy. Thereafter year-grouping is more difficult and for instance, they seldom place a mature cow in any category other than "middle-aged" or "old". The long period of gestation and the regularity of parturition are known to the sealers and immediately suggest to them an array of clearly-defined annual groups. Indeed, the allocation of specimens to such groups rather than to other kinds of age groups is automatic even if there is faulty evidence for so doing. The main criteria of these casual inspections of the females are appearance and physical condition, coat colour, condition of the teeth, colour of the nasal vibrissae and state of the reproductive organs. The age of the male is judged on nearly similar grounds but appearance in this sex bears a more striking relation to age. In addition an *os penis* may distinguish pubertal from prepubertal males. Behaviour of the seals can also be correlated with age. Thus yearlings seldom leave the environs of the rookery during their first year and usually suckle or sleep near cows in the early morning or late evening. Second-year animals are more independent and their movements erratic. Mature bulls spend considerable time foraging during the winter but evince stereotyped movements in their punctual return to land and in their relations with cows and other males at specific times of the year.

(i) Marking.

Marking by means of hot-iron brands or consecutively-numbered corrosion-resistent tags has obvious advantages for accumulating a supply of known-age animals (Rand, 1950 a, 1955 c; Scheffer, 1950 a). Up till now marked animals in

their second year have been recovered and five-year old brands were sighted on animals at the rookeries. As the bulk of animals are unmarked, identification in the field demands other age clues.

(ii) Date of Capture.

The time of capture need not be neglected in considering exact age. In fact, observers sub-consciously use this criterion when computing the age of the winter catch of young animals. It is explained as follows. Cows mostly pup during November although parturition may occur before and after this month. However, the simultaneity of pupping is striking and November may be designated as the start of a particular season from which ageing can be calculated. Pups moult in March and take on the yearling coat. Yearlings captured during a particular year may therefore be assigned an age corresponding to the month of capture plus one. Thus yearlings caught in August are likely to be nine months old. A few premature or unseasonal pups are exceptions to this rule. An idea of the age of small seals seen casually at sea is also based on consideration of the month of the year. Thus yearlings are not likely to be encountered until after the winter. Young subadults observed far off-shore are probably second- or third-years. Older animals cannot be treated on such a refined basis. The skull collection deals with animals taken at the same rookery during the summer; they are therefore of nearly compareable ages. Age grouping based on the skull characters is given a certain uniformity because of the annual significance of the date of birth and the relation that date of capture bears to this. In spite of the relation, date of capture gives limited aid to the reckoning of age and is applicable in practice to the younger groups only.

(iii) Coat Colours.

Coat colours assist in the estimation of age when this is based upon fleeting impressions or superficial inspection as often happens during sealing when the animals are flayed. While the young seals have very definite colours, this is not the case with older ones. In the latter, coat colour identification is made difficult by the varying number of different (and unknown) age groups involved. As a result of this little is known about the development of the coat in the adult.

The coat of the young *A. pusillus* is black, a characteristic of young fur seals generally. After about four months this coat changes into a thick olive-grey which darkens noticeably towards the end of the first year. The coat has a decided grizzliness in males reaching physical maturity. Old females on the other hand are more buff-coloured. Seasonal changes, mainly a spring fading, complicate individual and class patterns throughout the year. Nevertheless old animals assume their former colours shortly after the moult although gradually losing the warmer tones of physical maturity. Drabness seems to follow advancing age. The colourful patterns of moulting or freshly-moulted animals are a picturesque but transient part of the colours of a summer herd. Colour anomalies are otherwise rare. One bull with a russet coat lay on Sinclair Island for some days in the summer of 1948. On one occasion a copper-brown female stood out among the other cows until it was realised that she had lost all her outer hair. Coat colours are again discussed under the various suture groups.

(iv) Vibrissae.

There are about thirty short nasal (mystacial) vibrissae in the young pup. They are black for some years but turn white later. The colour of the two brow (superciliary) vibrissae hardly changes with age. Scott and Lord (1925) state that in the Tasmanian fur seal *A. tasmanicus*, the whiskers become quite black in old males. This is not so in other fur seal species.

The nasal vibrissae are arranged in six rows on each side of the snout. Counting the rows from the ridge of the nose downwards to the lip, the arrangement of the bristles is as follows: 3, 5, 6, 6, 6, 4 bristles. There may be up to thirty-three vibrissae on one side of the snout. Supernumerary whiskers (two) were noticed in one case only. A black pup was seen with pure white bristles on one side of the snout. The nasal vibrissae, black and rather weak in the pup, are much stronger in the sub-adult males. At physical maturity, however, males have long whitish bristles ranging from 13 to 22 cm long. Bristles are shorter at the anterior end of the snout, a condition apparently associated with the underwater movements of the seal. Black vibrissae are commonly found in primiparous cows and it is not till some years later that they are white. The superciliary vibrissae seldom exceed four centimeters in length.

The vibrissal formula varies among the pinnipedes (Mohr, 1952) and may have value in separating the different species. Although used in casual description it throws little light upon age.

(v) External Measurements.

The unreliability of body length measurements for accurate ageing of seals has been stressed from time to time (Bertram, 1940; Scheffer and Wilke, 1953). These authors have noted the practical difficulties of measuring true nose-tail lengths of heavy animals lying on rocky ground. They have also shown how length data may be confused by unknown age and seasonal variations. Until these variables have been assessed, it is impossible to use gross measurements for assessing and separating the annual groups. In spite of this there is a rough correlation between age and length in the young *C. ursinus*, an aspect that has had far-reaching application in their exploitation (Kenyon and Scheffer, 1954).

In *A. pusillus* body length frequencies are shown in Figs. 1 and 2, Plate III, from which it is possible to find the limits of the young classes only. Thus Black Pups are likely to be less than 95 cm and Yearlings between 95 and 135 cm long. The figures also show a rough distinction between the male subadults and bulls but there is no clear-cut relationship between length and age in old animals of either sex.

(vi) Reproductive Status.

Gestation takes nearly a year. The cycle is characterised by free blastocyst development for the first three or four months. Pregnancy and parturition umpose distinctive patterns on the genital tract in the summer (December, January and February). The uterus recovers its normal (non-pregnant) appearance three months after the birth of the pup, but the steady development of a new embryo in pregnant cows then repeats changes terminating in parturition. The undeveloped uterus of prepubertal females distinguishes them from older parous animals. Nulliparous, primiparous and multiparous uteri (identified by the appearance of the uterine wall and development of the embryo in alternate horns), because of the annual significance of gestation, readily separate specimens into these three broad (age) classes. Certain limitations regarding the application of this method of ageing are discussed in the next paragraph. Corpora lutea in the ovaries have been used to define the age of cows of other species (Bertram, 1940) but they do not persist as clearly recognisable bodies beyond three years in *A. pusillus*. After this, ovulation age is difficult to calculate from old scars. Placental scars have also been used to identify age in other mammals but they disappear within about three months after parturition in the Cape fur seal.

Owing to the possibility of missed pregnancies or erratic growth to sexual maturity as has been recently demonstrated in *C. ursinus* (Pearson and Enders, 1951), reproductive organs have limited value for exploring age. Confirmation from other data is usually necessary. Lack of absolute age-clues has hindered an understanding of any eccentric trends in ovulation in *A. pusillus*, but a broad classification of adult cows is nevertheless presented on the state of their genitalia, advantage being taken of the annual nature of cyclic changes in the sex organs.

Testis size in the male is influenced by seasonal changes and has little bearing on age in adult animals. The weight and length frequencies of 140 specimens are grouped together in Figs. 3 and 4, Plates III and IV. They indicate a possible but by no means clear division between immature and sexually-mature animals. More important is the os penis or baculum, an ossified extension of the corpus cavernosum, which shows a noticeable increase in size with age especially after the second year. Such accelerated growth just before sexual maturity has been demonstrated in many other seals (Havenga, 1933; Hamilton, 1939; Scheffer and Slipp, 1944). The bone of *A. pusillus* was considered to be of some value for analysing the composition of a sealing catch but it was found that accurate discrimination of age classes was not possible by this means. Length frequencies of 551 baculi from the 1946 catch are plotted in Fig. 5, Plate IV . There is a pronounced peak for baculum lengths lying between 115 to 125 mm. This range is covered by groups G to M, all physically mature bulls, but overlapping obscures any clear delineation of group lengths. The graph indicates a tendency on the part of the sealers to take bulls in their prime, the usual procedure during summer months.

1189—3

(vii) Dentition.

Scheffer (1950 b) pioneered a method of ageing by means of counts of the external rings on the roots of the canine teeth. He was able to show the age up to ten years of individual *Callorhinus*, *Eumetopias*, *Arctocephalus* but not of *Zalophus*. At the same time Laws (1952) computed the age of elephant seals, *Mirounga leonina*, by means of rings seen in transverse sections of the teeth. Laws found concentric rings of dentine associated with yearly growth in other seals from high latitudes, such as *Cystophora cristata*, *Hydrurga leptonyx*, *Phoca vitulina*, *Phoca groenlandica*, *Halichoerus grypus*, *Lobodon carcinophagus*, *Leptonychotes weddelli* and *Ommatophoca rossi*, all members of the *Phocidae*. Fisher (1952) and Fisher and Mackenzie (1954) have applied this method of ageing to the management of phocids hunted off the Canadian coasts. Teeth from the Cape fur seal were sectioned and examined but the numerous annuli showed no discontinuous pattern that could be correlated with definite annual or other ricognisable time units. Animals aged by marking may yet provide clues to the pattern of tooth-rings and so introduce their use in random ageing. It is of interest in this connection, however, that Scheffer himself could not allot tooth rings of *Zalophus*, a temperate latitude otariid, to age stadia and concluded that by comparison with *Callorhinus*, a low latitude migratory otariid, the former species lacked a well-defined temperature gradient in the ocean that might result in the discontinuous rings of the teeth. Similar rather stable temperature conditions appear to prevail over the limited range of the non-migratory *A. pusillus*. Except in the case of the breeding bulls, observations on the habits of this fur seal have so far failed to show any break in movements to and from the rookery that might be reflected in dentine deposition.

Van Beneden (1871) was the first to discuss the milk teeth of the *A. pusillus* pup but he was uncertain about the formula. Deciduous teeth are completely lost by the end of the first five months. Traces of the teeth are thus only found in the Black Pups (Rand, 1950 c). Growth of the permanent teeth is slow and it is not until the second year that the canines project above the height of the third pair of incisors of the upper jaw. The latter incisors and the canines are chiefly affected by wear in the male and the tips are abraded from the second year onwards. There was exceptional wear in one male which had all the teeth of the lower jaw worn to the gum level. The canines of the upper jaw of this specimen were quite blunt. Attrition is frequently a lateral wearing away of the canines and sub-caniniform teeth due to irregularities of articulation. A few animals had fractured canenes but on the whole the teeth were strong and abnormalities of wear or pathological cases were rare. In the female the third incisors and canines are also rather more worn than the other teeth. The post-canine or molar teeth were little changed even in the oldest cows. Supernumerary teeth have been recorded occasionally.

Taxonomists have subdivided the genus *Arctocephalus* on the position of the teeth in the jaws, on the presence of cusps and also on the extent of subdivision of the roots of the teeth in the various species (Gray, 1859; Peters, 1975). Furthermore Sivertsen (1954) describes how the creation of a subgenus *Arctophoca* depends upon the relatively small number of cheek teeth in the upper jaw. Although this view has been rejected by King (1954) on the grounds that the cheek teeth are variable in number, it nevertheless shows that dentition is an important feature in descriptions of the seals. In *A. pusillus* molars of both jaws have two accessory cusps. The first four molars are single-rooted, the fifth partially so and the sixth completely double-rooted. The incomplete division of the root of the fifth post-canine was recognised long ago as having diagnostic value in this species (Gray, 1866). The fifth molar lies at the level of the hind edge of the jugal arch, the sixth molar wholly posterior to this edge. The interpalantine suture lies between these two teeth. Further remarks about the teeth are made under the various age groups.

(viii) Degree of Ossification.

Sapin-Jaloustre (1952) shows a radiograph of the posterior flipper of a young Weddell seal, *Leptonychotes weddelli*, to illustrate the degree of ossification of the ankle bones. This method has been used with some success by the medical profession to age humans up to about 25 years. It has not been possible to relate the degree of ossification of bones with age in *A. pusillus*.

(ix) Cranial Features.

When a series of skulls is sorted according to say, increasing length, there is a corresponding change in other characters. Thus the squat skull of the pup elongates after the first few months, facial length outstripping width, and this is followed in later years by wide alterations of the facial angles,

growth of the bone, closure of sutures and development of ridges and excrescences. The rounded features of the pup become gnarled and angular in the adult. Skulls are easy to preserve and were used widely in systematic work in the past, but failure to recognise the effect of both advancing age and progressive variations has at times confused their identity (Turner, 1868).

Graded skull features (length, weight and appearance) are important when describing the growth of the seal. They have figured frequently in attempts to find the age of the animals (Smirnov and Chapsky, 1932), but the role of sutures has perhaps played the major part. Hamilton (1934) successfully arranged male *Otaria byronia* skulls into age groups according to the degree of suture closure. Bertram (1940) examined sutures in two Antarctic phocids but considered them of less value than a broad correlation of body and skull dimensions. In the case of the female he considers that it is necessary to combine the extent of suture closure and measurements of skull and body length with data from ovarion inspection. Doutt (1042) surveyed the advantages of age determination by means of sutures and worked out a " suture age " method for comparing species within the genus *Phoca*. Scheffer and Wilke (1953) and Laws (1953) disregard suture closure in the face of more exact methods of ageing by teeth rings. Sivertsen (1954) has recently revived the suture closure method of ageing, applying it in a survey of otariid skulls. By giving a value (1 to 4) to the degree of closure of certain sutures, he was able to assign a " sutural age " to the various skulls. In this way he compared skulls of different species on a definite bases (suture age) and formed three workable groups namely, adults (suture age 19–36), young ones (10–18), and cubs (9–10). Sivertsen could find little connection between the absolute age and suture closure, and thus the suture method remains a good means of comparing individuals rather than of indicating ages within the limits of accuracy necessary in management. Once the suture age groups have been placed on a chronological basis, then this method may have wider application. From reports of both Doutt and Severtsen, grouping by suture age promises to play a valuable part in systematic work.

In the present report progressive changes in the skull are considered alongside one principal feature, the suture. Ten sutures were used to set up and separate groups of progressively greater relative age in the collection of over 217 male and 185 female skulls. Relative ranking of individual skulls was fairly simple and the first step was to spread the specimens in a continuous series commencing with the youngest and ending with the oldest skulls. As repetition of general features occurred, groups of skulls of similar appearance were immediately apparent. Fusion of particular sutures was used as far as possible to delimit these groups. Grouping in the female was confirmed by reference to the state of the genitalia. Occasionally sutures showed anomalous closure when other evidence pointed to a greater age. Northwithstanding these exceptions, skulls could usually be allocated to one or other group. Suture grouping was valid for the younger animals where true age could be determined by branding. Thus the basoccipital-basisphenoid suture closes at twelve months. But in the older animals the grouping here adopted must have a relative value only, unless other methods will show a close correlation between the time of closure and the attainment of a particular age. Suture grouping has a practical convenience nevertheless, which merits its retention until such time as specimens of known age provide the necessary basis for chronological age classifications. For material accumulated but not critically examined in the field, suture grouping has much practical value.

The order of closure was found to be as follows: first suture of the series to close is the basoccipitol-basisphenoid which is followed in turn by the exoccipital, interparietal, parieto-frontal (coronal), squamoso-parietal, maxilla-jugal, maxilla-pre maxilla, basisphenoid-presphenoid, internasal and naso-maxilla.

The rate of closure is known for young animals only, there being small difference between the sexes. However, in adults the basisphenoid-presphenoid of the male remains open until the maxilla-premaxilla has fused. In the female this suture closes before the maxilla-jugal. This anomaly depends upon the almost continuous growth of the male skull to a larger size. Sutures of the palate close gradually, the palato-maxillary being the last to fuse. In *C. ursinus* the only seal where the rate of suture closure has been determined, it was found that this was variable (Scheffer and Wilke, 1953), the basoccipitol-basisphenoid for instance, closing in the male between the age of two and seven, but in the female between the age of two and three years.

Male skulls are separated into eleven somewhat arbitrary groups as shown in Table 1, the open sutures being marked " O ", the closed sutures " C "and the incompletely-closed sutures " (C) ". The young groups A to E can be allocated to

definite annual classes or animals of a particular season. Some of the oldest specimens were placed together in a final group probably differing widely in age. This group has similarity in suture closure but does not necessarily refer to annual or other chronological groups.

TABLE 1.

EXTENT OF SUTURE CLOSURE IN MALE SKULLS.

Suture.	Groups.										
	A.	B.	C.	D.	E.	F.	G.	H.	J.	K.	L.
Basoccipito-basisphenoid	O	O	C	C	C	C	C	C	C	C	C
Occipito-parietal	O	O	(C)	C	C	C	C	C	C	C	C
Interparietal	O	O	O	(C)	(C)	C	C	C	C	C	C
Parieto-frontal	O	O	O	O	O	(C)	C	C	C	C	C
Squamoso-parietal	O	O	O	O	O	O	(C)	C	C	C	C
Maxilla-jugal	O	O	O	O	O	O	O	C	C	C	C
Maxilla-premaxilla	O	O	O	O	O	O	O	O	C	C	C
Interfrontal	O	O	O	O	O	O	O	O	(C)	C	C
Presphenoid-basisphenoid	O	O	O	O	O	O	O	O	O	C	C
Internasal	O	O	O	O	O	O	O	O	O	O	(C)
Naso-premaxilla	O	O	O	O	O	O	O	O	O	O	(C)
Interpalatine	O	O	O	O	O	O	O	O	(C)	(C)	C
Palato-maxilla	O	O	O	O	O	O	O	O	O	O	C
Intermaxilla	O	O	O	O	(O)	(O)	O	O	(C)	(C)	C
Pterygoid	O	O	O	O	(C)	(C)	C	C	C	C	C

Female skulls are divided into twelve convenient groups as shown in Table 2. Sometimes incompletely-closed sutures marked "(C)", were important and are bracketed in this table. Skulls which agreed with the stipulated extent of suture closure were put into the relevant group.

TABLE 2.

EXTENT OF SUTURE CLOSURE IN FEMALE SKULLS.

Suture.	Groups.											
	A.	B.	C.	D.	E.	F.	G.	H.	J.	K.	L.	M.
Basoccipito-basisphenoid	O	O	C	C	C	C	C	C	C	C	C	C
Occipito-parietal	O	O	O	C	C	C	C	C	C	C	C	C
Pterygoid	O	O	O	(C)	(C)	C	C	C	C	C	C	C
Interparietal	O	O	O	O	(C)	C	C	C	C	C	C	C
Parieto-frontal	O	O	O	O	O	O	C	C	C	C	C	C
Squamoso-parietal	O	O	O	O	O	O	O	C	C	C	C	C
Basisphenoid-presphenoid	O	O	O	O	O	O	O	O	C	C	C	C
Maxilla-jugal	O	O	O	O	O	O	O	O	O	C	C	C
Maxilla-premaxilla	O	O	O	O	O	O	O	O	O	C	C	C
Interpalatal	O	O	O	O	O	O	O	O	O	(C)	(C)	C
Intermaxilla	O	O	O	O	O	O	O	O	O	O	(C)	C
Interfrontal	O	O	O	O	O	O	O	O	O	O	(C)	C
Internasal	O	O	O	O	O	O	O	O	O	O	(C)	C

(b) Group Characteristics.

(i) The Black Pup (Group A).

The litter of the year is a distinct group, crowding the rookeries during and for some time after the summer breeding season (October to February). Black pups are normally born in November and early December. Dead foetuses are common in the winter and premature pups may be dropped in late October but the bulk of the group is born a month later. A few new-born pups are an unexplained anomaly at the rookeries during early winter (May to June) when the dominant class is the yearling.

The first impression of coat colour is a uniform velvety-black, often lighter below. Details of colour may vary on the belly from light-grey to deep chocolate. Degrees of grizziness and the composition of the outer coat are responsible for most of the colour effects. The coat of the new-born pup is composed of three types of hair-fibre: long, straight, white-tippid hairs (15 to 20 mm) sparsely scattered over the whole body; shorter, curled, black hairs (10 to 15 mm) forming the main mass of the coat; and thin silky fibres almost the same length as the black hair.

The nose, and the soles of the flippers are grey in the new-born pup but after a few days turn black. Complete albinos have not been seen but there are frequent cases of partial albinism (white vibrissae). The three inner digits of the hind flipper are of nearly equal length (the middle digit is a few millimetres shorter than the other two) and slightly longer than the outer pair. They are for instance, more tapering than the stumplike digits of the fur seal of Gough Island. Hair extends to the base of the claws which almost reach the level of the interdigital web of the hind flipper of the new-born animal. The distance from claw-base to tip of the digit is twice as much as the distance from claw-base to edge of the web. Claws are 15 mm long and turn inwards in the new-born pup. As a result of grooming they become characteristically worn in older animals, the tip of one claw pointing in an opposite direction to that of the other two.

One pup is born each year. Only three instances of unborn twins were recorded. A sex ratio slightly over one is in favour of the male. Data about this ratio were derived from random counts of the black pups on three occasions:—

Tagging in 1947 with Sivertsen discs (Sinclair Island).—528 males—419 females. Sex ratio 1.2 : 1.

Branding in 1948 on Sinclair Island.—66 males—59 females. Sex ratio 1.1 : 1.

Tagging in 1954 with Hasco tags on Seal Island (False Bay).—167 males—133 females. Sex ratio 1.2 : 1.

TABLE 3.

WEEKLY WEIGHT CHANGES (lb.) IN BLACK PUPS.

Week.	Males.				Females.	
	636.	646.	648.	652.	647.	582.
1	15·5	15·5	—	15·3	15	13
2	18·5	17	19	17·5	17·5	—
3	21·5	21	20·5	17·5	16	—
4	23	23	23	20	—	—
5	23	24·5	25·5	18	20·5	—
6	24	25·3	—	—	21·5	—
7	—	—	28·5	25	22	19
8	25·5	—	23·8	25	20·5	22·5
9	26	30	—	24·5	24·5	22·8
10	31	—	26·5	—	—	25
11	—	30·5	21·5	—	—	—
12	30·5	—	—	—	—	25·5

Changes in size are greatest among the males which may double their weight by the second month. Male pups are generally more robust than the female. But the growth of the young pup is subject to many hazards among a cramped herd of adults exhibiting little or no parental care. Weights of marked pups taken at weekly intervals (Table 3), while showing a faster rate of growth for the male, clearly demonstrate the continual fluctuations that follow irregular suckling.

The change in weight of the class was deduced from weights of both live and dead pups. In Table 4 the body-weights (in lb.) of live pups are printed above those of dead ones and are followed by the number of specimens weighed during the respective months. The monthly mean weight of the dead pups (for the years 1948 and 1949) is shown graphically in Fig. 6, Plate IV. No animals were weighed during May, June and July when the pups fall into the yearling class. Although there were big differences in body weights, which depended upon the frequency and success of suckling before capture, there is a fairly rapid upward trend in weight during successive months. By April the pups are sturdy animals with maximum weights of over 50 lb. (males) and 38 lb. (females).

TABLE 4.

MONTHLY WEIGHT CHANGES (lb.) IN BLACK PUPS.

Month.	Males.				Females.			
	Maximum.	Mean.	Minimum.	Number.	Maximum.	Mean.	Minimum.	Number.
November	18·5	13·2	11·0	14	14·5	12·1	10·0	22
	16·3	13·4	5·6	32	14·0	11·0	8·0	26
December	26·5	20·1	11·5	34	21·5	17·1	12·0	26
	23·0	15·9	11·0	4	—	10·5	—	1
January	35·0	24·6	15·0	41	26·5	22·5	17·0	30
	26·0	19·7	13·0	4	20·0	14·8	9·5	2
February	38·5	33·9	19·0	25	25·5	23·7	21·5	9
	38·5	29·5	15·5	3	12·3	11·6	11·0	2
March	50·5	39·1	25·5	39	37·5	28·5	22·5	42
	38·3	36·9	35·0	3	27·5	20·0	12·0	3
April	52·5	42·3	34·5	42	39·0	33·4	27·5	43
	—	13·0	—	1	—	13·0	—	1

The pup suckles within an hour of birth, sometimes sooner. The shape of the permanent incisors of both jaws enables the pup to grip firmly the nipple which protrudes when the cow shifts her body into a nursing position. When she mates again five or six days later, the cow leaves her pup for the first time but returns within a day or two. Absenteeism increases until the cow stays away from her pup for over a week at a time. In the *Callorhinus* female the periods at sea are of much the same length but appear longer at first than is the case in *A. pusillus*. *Callorhinus* spends from $4\frac{3}{4}$ to $8\frac{3}{4}$ days at sea when she first leaves her pup (Bartholomew and Hoel, 1953). Data about weight changes during early nursing were gleaned from marked *A. pusillus* pups. Thus at the age of eleven days, a male pup (serial number 648) weighed 19 lb. (Table 3). Thirteen days later it weighed 23 lb. In the interim the pup was with its mother for six days (two periods of suckling) and was weighed three days after the last meal. Another male pup (serial number 636) weighed 15·5 lb. at birth (Table 3). Six days later it weighed 18·5 lb. Fifteen days afterwards when the cow had been away three times (a day on each occasion), this pup weighed 23 lb. but lost $1\frac{1}{2}$ lb. a week later. Pups may be without milk for nearly two weeks during the second month. Through

their ability to feed strongly when nursed they can regain lost weight and indeed, a 20 per cent increase was recorded in one case. No doubt greater weight increases take place when the herd is undisturbed. The high protein content of the milk accounts for the big weight changes before weaning (Sivertsen 1941). Analysis of a sample of milk from *A. pusillus* (Seal Island, False Bay) gave the following percentage composition*:—

Fat 18·6 per cent, Protein 10·0 per cent, Ash 0·86 per cent.

Although the protein and fat content is greater than that of many domestic animals (Maynard, 1937), the fat of the *A. pusillus* sample is not as high as that of phocids and cetaceans inhabiting colder regions. Amoroso and Mathews (1951) report that a sample of milk from *Halichoerus grypus*, the Grey seal of the North Alantic, contained 52·2 per cent fat, 11·2 per cent protein and 0·7 per cent ash.

The length of the body of new-born pups lies between 60 and 70 cm. Although several females were longer than males at birth, this ratio alters in a month or two when males collected on Sinclair Island were consistently longer than females. Length-changes within the class are given in Table 5 dead pups only) and the monthly average is illustrated in Fig. 7, Plate V.

TABLE 5.

MONTHLY LENGTH CHANGES (cm.) IN BLACK PUPS.

Month.	MALES.			FEMALES.		
	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.
November	87	76	64	86	73	64
December	85	78	69	—	72	—
January	90	86	80	86	78	70
February	95	91	84	81	80	79
March	107	96	91	90	84	79
April	—	82	—	—	84	—

The somewhat rounded, fragile skull of the pup has open sutures and is dominated by a squat snout and wide cranium. Temporal ridges are absent (Fig. 24 A, Plate XI). The cranial bones are smooth. There is an indistinct T-shaped parietal pattern on the top of the skull. Skull weights do not exceed 131 gm in the male and 100 gm in the female. Skull proportions vary but for two months the zygomatic width is greater than the facial length when this is calculated as the distance from the hamular process to the tip of the premaxilla (gnathion). Thereafter this ratio changes (Figs. 8 and 9, Plate V). There is generally but not always a great disparity in sezi between male and female skulls (Figs. 12 and 13, Plates VI and VII). Greater development of the lower mandible of the male distinguishes the sexes at birth.

During development of the teeth, the first two incisors are lost in utero, the first canines some five months after birth (Rand, 1950 c). Black pups therefore, are mostly equipped with milk teeth, the formula of which is:—

$I\frac{3}{2}$, $C\frac{1}{1}$, $M\frac{3}{3}$.

There is a diminutive os penis in the male, which is a short rod-like bone slightly curved anteriorly and reaching a maximum length of 43 mm. (weight 0·6 gm within the class.

(ii) The Yearling (Group B).

When they lose their black coats pups graduate to the yearling class, a much sought-after group frequenting the rookeries during most of the year. Winter sealing is directed against this class exclusively and catches are made from late July until September when the animals are from eight to ten months old. The pelt is partially stripped of blubber, salt-cured and exported for sale overseas. Oil from the blubber and vitamins from the liver are valuable by-products from the seals. In the past carcasses were reduced to a mixed bone and meat meal.

Although the majority of pelts come from the one-year old seals, the catch of 1949 included thirty-one animals branded the previous year as yearlings. No doubt all winter catches contain a

* The composition of this milk sample was determined through the courtesy of the Government Chemical Laboratory, Cape Town.

varying number of two-year old specimens. This aspect must of course be considered when analysing the catches. Specimens taken during the months December to April (group C) are therefore compared with those from earlier months although the former (called young second-years) have not reached the physique of their winter counterparts. The juvenile behaviour and special attributes of the yearlings make them a target for the sealers whose operations are intimately bound up with their habits. Proper identification of this group is important in the field.

The pup coat is replaced during an autumnal or late summer moult (February to March). The new coat is olive-grey, uniform in both sexes. It is composed of thick, white-tipped black hair which is translucent at the roots. Variations in both length and colour of the tip give rise to a wide range of colour impressions. Thus the white tips of the hair on the head, shoulders and back are about half the length of those on the belly. In addition the latter are more yellow or chocolate coloured. There are traces of yellow round the jaws. The back and the base of the flippers are blackish-brown. A coppery underfur lies under the guard hairs and may reach to about half their length. The growth of this underfur has not been studied in detail. It reaches primeness in August and September of the first year as far as can be ascertained,

Blubber, the chief source of oil, is important to the sealing industry. From Fig. 10, Plate VI, it is seen that there is a rise in the weight of blubber during August, September and October but thereafter it falls. Loss of weight coincides with weaning and the transition to an independent diet. Weights rise again in the late summer and autumn (Fig. 6, Plate IV). Having gained their permanent teeth by June, the yearlings forage locally to supplement their milk diet but milk remains the principal food until weaning takes place in October. The absorption of fat after weaning (when the animals adjust themselves to independent foraging) accounts for the low blubber content of young second-years. The high blubber yields from milk-fed yearlings in August, September and October indicate an optimum time for exploitation of this source of oil.

The degree of fatness described as corpulency (Sminov, 1927; Sivertsen, 1941; Laws, 1953) has a bearing on calculations of blubber content (Fig. 11, Plate VI). Corpulency is high in September and October but drops steadily after the summer when the yearlings lose their rotund appearance and become more streamlined through irregular feeding and greater activity at sea. In the spring there is little difference in corpulency between the sexes.

TABLE 6.

BODY WEIGTHS (lb.) OF LIVE AND DEAD YEARLINGS.

Month.	Males.				Females.			
	Maximum.	Mean.	Minimum.	Number.	Maximum.	Mean.	Minimum.	Number.
August	100·0	76·9	39·0	42	66·5	46·4	20·0	19
	53·0	52·5	52·0	3	61·5	52·5	43·5	2
September	90·0	65·6	29·0	40	68·0	55·2	33·0	32
	82·5	66·4	51·0	5	—	47·2	—	1
October	85·0	65·8	51·0	39	68	51·6	43·0	26
	76·0	69·5	62·0	3	—	57·5	—	1
November	61·0	52·1	44·0	4	—	—	—	—
	125·0	60·8	41·5	10	76·8	53·7	33·8	5
December	64·0	59·0	52·0	4	—	44·0	—	1
	123·5	83·4	61·5	15	75·0	64·5	45·0	8
January	—	—	—	—	—	—	—	—
	128·0	97·7	62·3	14	66·5	57·7	42·0	4
February	—	—	—	—	—	—	—	—
	131·0	94·4	58·0	7	81·0	68·8	47·0	3
March	—	—	—	—	—	—	—	—
	133·0	114·0	96·0	3	—	—	—	—
April	—	—	—	—	—	—	—	—
	119·5	109·8	100·0	2	—	71·0	—	1

At first body weight follows much the same trend as corpulency; there is a slight drop in November but then it increases steadily (Fig. 6, Plate IV). The heavy weights of yearlings shown in Table 6 (weights of live pups are printed above those of dead ones) were attributed to more regular suckling in a winter herd confined to the rookery by high seas and not disturbed from May until August (1948).

Head-tail length increases steadily during the year, males developing from about 40 inches (102 cm.)in August to over 55 inches (142 cm.) the following April (Fig. 7, Plate V). Details of body dimensions of live and dead yearlings are given in Tables 6 and 7.

TABLE 7.

BODY LENGTHS (cm.) OF DEAD YEARLINGS.

Month.	MALES.				FEMALES.			
	Maximum.	Mean.	Minimum.	Number.	Maximum.	Mean.	Minimum.	Number.
August	108	102	93	3	110	106	102	2
September	119	110	104	5	111	103	94	9
October	121	116	112	3	—	111	—	1
November	143	117	107	10	126	111	108	5
December	144	127	111	15	126	117	108	8
January	150	135	120	14	123	116	106	4
February	142	133	119	7	130	123	116	3
March	148	140	131	3	—	—	—	—
April	145	142	140	2	—	129	—	1

The yearling skull has enlarged and relative proportions resemble those of the older groups. (Fig. 25, Plate XII). Increase in snout-length emphasises the general direction of skull growth. Thus there is a 36.2 per cent increase over the hamulo-premaxilla length of the Black Pup. The contour of the skull is still smooth but temporal ridges are visible and now form a characteristic "T-shaped" pattern on the dorsal surface of the cranium. The outline of this parietal pattern is typical of the first year but disappears later with closure of the temporal ridges. All important sutures are open. By December the skull reaches a length of nearly 190 mm. in the male, 170 mm. in the female (Figs. 12,13, Plates VI and VII). The milk teeth are lost by June and the permanent dentition shows no sign of wear. Although spasmodic foraging takes place after the winter, teeth are rarely stained. The dental formula is now:—

$$I\ \tfrac{3}{2},\ C\tfrac{1}{1},\ M\ \tfrac{6}{5}.$$

Canine teeth are not yet prominent in the male and are about the same height above the gums as the third incisors (Fig. 25 b, Plate XII).

The baculum of the male has enlarged, doubling its former weight and length. The average weight is now 0.7 gm., the average length 53.3 mm.

The regular movements of the yearlings aid in their identification. They are at or near the rookeries throughout the year, crowding the rocks in stormy weather or lazing in characteristic "pods" nearby. They return to land to seek their mothers at times coinciding roughly with the arrival of the latter from the sea. The whimpering cry of the yearling calling its mother is unmistakeable and particular animals can be identified by vocal characters. Calls are made by other classes but these are irregular and seldom heard except in fighting or play. The plaintive calling of the yearling and the answering bellows of the cows stand out above the indistinct vociferations of the general herd and offer a clue to the whereabouts and age of these animals.

(iii) Second-years (Group C).

Group characteristics are derived from summer representatives of the second-year stock. They refer to animals from twelve to eighteen months old. In a few cases age was ascertained from branded animals and checked against a continuous series of skulls. Skull dimensions have increased over those of the last group and incipient closure of the temporal ridges obliterates the parietal pattern which is now an ever-diminishing shallow depression on the mid-line of the skull. It disappears in the next group where closure of the

1189—4

temporal ridges is complete. Fusion of the basoccipital-basisphenoid suture occurs in this group. Older skulls have the occipito-parietal suture closed.

Some startling coat colours are encountered in summer second-years. Young animals have the faded yearling coat until February when this is moulted to a bright Mineral Gray. Males may be blackish-brown before the moult, the females more fuscous. Afterwards the new coat becomes olive-grey, more grizzled in the male. A yellow strip round the jaws is prominent in both sexes. Undersized second-years are easily mistaken for yearlings during the winter but the faded brown coats of the former class distinguish them immediately. It nevertheless happens that they are inadvertently included in winter catches at all rookeries. This may occur when the sealers meet mixed parties playing at the water's edge or congregating on the outskirts of the herd. Coat colours are difficult to recognise when wet or dusty. In these circumstances the second-years can be detected by other features such as superior strength, heavier and more muscular build, general agility and experience in fighting or play and by the fact that they are shunned by the yearlings when about to engage in boisterous play. Unfortunately they are difficult to separate during a speedy " knock-down " or in the nets when the sealers inevitably kill both classes. The fur is said to have an inferior quality and this detracts from the usefulness of second-year pelts as part of the winter catch.

Average body measurements have increased substantially. Total weights of the male are highly variable during the spring but by the autumn there is a regular upward trend (Fig. 6, Plate IV). The recorded maximum for autumn second-years was 133 lb., a weight which reaches 160 lb. some six months later. Length averages 134 cm in the male with a maximum of 150 cm, and in the female 120·5 cm with a maximum of 130 cm.

Cranial dimensions are also greater than those of the preceding group (Fig. 13, Plate VII). The average length of the skull is 200·8 mm in the male and 181 mm in the female (Tables 11 and 12). The canine teeth of the male project far beyond the incisors. There is a 143 per cent increase in weight and a 30 per cent increase in length of the baculum of the male.

The monthly average of weight and length of the testes (Table 9) from group C and D are compared in Fig. 14, Plate VII. The two series of data given in this figure illustrate monthly fluctuations during the summer and autumn. While testis length changes but slightly, testes weight increases appreciably after December in group C (thirteen-month old yearling) but hardly rises thereafter until April. Actual weights of testes are shown in Fig. 15, Plate VII, for the younger sub-adult groups. No records are available for the winter months (June to August) and the first group D records come from November. It is then that high testis weights are suddenly encountered but these drop rapidly over the next few months. The baculum length increases at the same time. The monthly growth of this bone is not as spectacular as the interclass increments recorded in Table 8, but the bone does lengthen considerably to reach a large size in the spring of the second year.

TABLE 8.

GROWTH OF THE OS PENIS.

Group.	TOTAL WEIGHT (gm).				TOTAL LENGTH (mm).			
	Maximum.	Mean.	Minimum.	Percentage Increase.	Maximum.	Mean.	Minimum.	Percentage Increase.
A	0·6	0·3	0·1	—	43	32	14	—
B	1·0	0·7	0·2	130	61	53	45	66·5
C	2·6	1·7	0·5	142·8	82	69	56	29·8
D	5·8	4·5	2·5	158·8	111	95	81	37·1
E	7·2	5·6	3·2	27·2	110	99	85	3·6
F	8·5	6·8	5·5	21·4	121	109	102	9·1
G	12·5	9·6	6·9	41·1	128	119	99	9·2
H	14·0	11·8	8·3	23·9	135	122	109	2·4
J	16·8	12·3	9·0	4·2	137	122	108	0·3
K	14·3	11·4	8·0	—	123	119	109	—
L	15·2	12·0	9·5	5·2	135	126	119	5·5

TABLE 9.

AVERAGE TESTIS WEIGHTS (gm) FOR GROUPS B TO F.

Month.	GROUP.				
	B.	C.	D.	E.	F.
August	2·0	—	—	—	37
September.	2·5	—	—	—	36
October	2·5	—	—	24	—
November	2·0	6	4	38	—
December	3·0	11	31	35	33
January	—	11	27	34	34
February	—	10	22	30	—
March	—	11	20	—	—
April	—	16	15	—	—

From histological examinations of sections of the testis from various months (excluding the winter), no ripe sperm were found in any group C animals (summer or autumn) but were first found in group D specimens collected in November. By correlating the histological work with clues offered by the growth of the testis and baculum, it was found that sexual maturity (as based upon the presence of ripe sperm and the ability to mate) is reached in the third summer when the young males are at most 24 months old. As no specimens come from the winter and spring, the exact onset of sexual maturity is not known.

All females are virgin in the summer and autumn of their second year but reach sexual maturity during the following winter and spring (Rand, 1955 a). The possibility of erratic growth to maturity could not be investigated.

(iv) Groups D–M.

For convenience of description groups D to M are not completely separated, but are dealt with as sections corresponding to the sexual status of the animals. They are all sexually mature, the males developing to a great physical size but this is less marked in the females.

Males.

Sub-adult Groups D–F.

Third-year males (group D) have attained sexual maturity and occasionally mate in the summer when the larger bulls are removed during intense sealing operations. They are young bachelors and are an unstable but important class in any herd. They are recruited from animals escaping the winter sealing and the intensity of the latter operations have a profound effect upon their abundance.

Coat colours do not assist very much in the indentification of the subadults but they lack the thick neck hairs which form a characteristic " wig " in later groups. While the younger subadults have coats of various shades of olive (Dark Blackish Gray, Dark Fuscous, Olive Brown), darker tones appear in the older animals.

Average body dimensions give only slight indication of class exclusiveness. Thus the nose-tail length, calculated as a percentage increase between the classes, falls after group C but rises again when the animals reach physical maturity (group G). The percentage increase in body weight and length is shown in Table 10.

While weghts of all group E, F and G males could not be taken certain weight percentages in Table 10 are bracketed for this reason), it is apparent that the heavy weights associated with physical maturity are attained in the last group G males.

TABLE 10.

PERCENT INCREASE IN BODY WEIGHT AND LENGTH.

Group.	Length.		Weight.	
	Males.	Females.	Males.	Females.
A	31·7	28·3	180	212
B	20·3	18·1	64·7	47·7
C	18·1	11·4	64·9	41·5
D	0·6	6·3	(14·5)	16·1
E	1·0	6·5	(16·1)	20·5
F	9·9	2·0	(37·9)	7·7
G	5·7	4·1	3·2	10·8

The cranial pattern of the subadults starts to alter in group D where there is a narrow flattened ridge on each side of the interparietal suture. The sagittal crest is absent but the nuchal ridges are high. Skulls of group E are similar in this respect. In group F the sagittal crest is hardly more than a low ridge running between the parietals (Fig. 26, Plate XIII). A peculiar network is occasionally seen in this group as a raised etching on the parietals. It is more pronounced in older males.

Third- and fourth-year males are not normally found in the breeding herd until territorial control relaxes. They are usually abundant on the rookeries in the late summer when moulting occurs. Their pelts are fairly free of lacerations but scarcity of numbers (as compared with the yearlings), sparse fur and low blubber content safeguard them against exploitation during the non-breeding season. Group F males may be found in catches from the end of the summer season when the larger bulls have been removed. They are fair-sized animals but do not indulge in the bitter territorial fights of the older males.

Bulls (Groups G to L).

Adult males are a conspicuous class during the summer when territorial behaviour and physical condition set them apart from the other animals. During the rut their status in the herd gives rise to three very distinct categories, which are liable to merge into each other if conditions on the rookery alter. Thus there are the large " harem bulls " which dominate groups of cows, the less successful (from a mating point of view) " idle bulls " which are frequently seen occupying territories without cows or which do not acquire a station on the rookery, and thirdly the decrepit non-breeding males which seldom mate with cows unless the other males have all been removed by intense sealing. The categories of adult males are transitory and disappear after the summer breeding season but they are very real in the hierarchy of classes and economy of the herd. Their recognition is important in management and exploitation. On the Pribilof Islands the classification of the bulls is the basis of the annual count or census taken in the summer. This technique would greatly aid management of the South African herds as it enables accurate enumeration of a commercially desirable class of seal, as well as providing information about the winter escapement of yearlings. In the winter and other non-breeding months, the bulls are less striking and their appearance or behaviour gives a less reliable indication of age.

The coarse outer coat of the bull is a uniform Mouse Gray, lighter below. There is a heavy mantle or " wig " of long, tough grizzled hair on the nape of the neck and shoulders. Individual hairs may be white-tipped to a varying degree and some are altogether white. The thick neck hairs are an adaptation to the typical method of fighting which is indulged in by adult males when settling territorial disputes. There is no distinct pattern of the coat as is seen in the contrasting yellow on the chest of the adult *A. gazella* of Marion Island. Fading of the coat in the summer results in various shades of brown, and after moulting older animals fail to regain the darker tones of those in their prime. Wet coats appear much darker than when dry. Soiling and staining by excreta while the animals are lying on the rock alters the colour of the coat until it may merge fairly well with the yellowish-brown background of the seal rock.

Table 11.

General Data about Male Suture Groups.

Group.	BODY MEASUREMENTS.						SKULL MEASUREMENTS.											
	Length (cm).			Weight (lb.).			Total Length (mm).			Total Weight (gm).			Zygomatic Width (mm).			Hamulo-Premaxilla Length (mm).		
	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.
A.....	98	84·5	67	38	21·1	5	161	141·2	113	131	106·5	43	90	80·6	65	95	79·5	61
B.....	121	111·3	93	82	59·1	41	188	179·6	172	203	166·0	138	105	99·6	94	114	108·3	101
C.....	150	134·0	119	133	97·4	55	215	200·8	181	357	266·3	164	123	112·8	98	136	124·8	109
D.....	172	158·3	149	204	160·7	(86)	230	221·5	212	445	384·4	333	132	128·0	124	150	141·6	132
E.....	178	169·3	154	213	184·0	152	241	229·9	220	570	457·7	349	146	134·7	127	155	148·2	142
F.....	220	186·6	172	264	214·2	177	253	240·6	230	741	585·0	477	148	141·0	133	178	157·5	147
G.....	227	205·2	184	305	305·0	305	262	254·0	246	946	782·6	671	162	155·0	145	179	168·5	156
H.....	231	217·0	197	315	315·0	315	271	259·8	251	1,020	891·3	757	167	161·0	152	184	172·8	165
J.....	241	222·4	197	657	502·5	376	283	260·5	237	1,168	988·1	799	177	164·5	150	191	173·8	163
K.....	230	216·8	195	479	386·5	294	276	260·0	246	1,115	962·0	841	169	164·3	159	186	172·9	161
L.....	234	223·0	206	493	413·0	329	271	265·0	255	1,162	1.044·0	883	179	169·1	159	191	178·3	170

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Some bulls reach a length of nine feet but do not acquire the massive build of the sea lions (*Eumetopias*). Body length, rising slightly at sexual maturity, is accelerated at the attainment of physical maturity (Fig. 16, Plate VIII). Thereafter length is more or less constant (Table II). Body weights could not be collected regularly. Nevertheless from Fig. 17, Plate VIII, it is seen that there is a relatively constant trend in the younger groups but large fluctuations in the weight of the summer bulls of groups F to M. This is due entirely to their physiological condition before and after the rut. Intensive foraging in October enables the bulls to go without food for some six weeks when maintaining territorial control on the rookery. As the blubber reserves are depleted, bulls lose weight and become thin and dishevelled by the end of the mating season. From girth and blubber measurements it is calculated that bulls may reach 800 lb. in the summer (see Shortridge, 1934). Weights of skin and blubber during the summer are shown in Fig. 18, Plate VIII, and the relation between girth and length (corpulency) in Fig. 19, Plate IX.

The adult male skull is strong and heavy. Sagittal and nuchal crests are high. Tuberosities arise through greater development of the parietal network. Skulls increase in length throughout groups G to L but there is a decided decrease in the last group where closure of all sutures in certain animals suggests that growth has ceased. Skull dimensions are listed graphically in Fig. 20, Plate IX. In the male there is a regular sigmoid curve for the growth of the skull, with two blunt peaks corresponding to sexual (group D) and physical (group G) maturity. Growth of the female skulls shows a smoother curve.

Skull characters point to the specific identity of the animal but they also provide clues to relative age. In taxonomy they have had widespread use within the genus *Arctocephalus*. At one time the form of the palate differentiated several species (Gray, 1859), but because of its variability gave rise to the erroneous description of at least one new species at the Cape, *A. schist-hyperoes* (Turner, 1868). The writer had no difficulty in separating adult skulls of *A. pusillus*, *A. gazella*, *A. australis* and *C. ursinus* on size alone. The various species may now be identified more easily through the excellent series of skull measurements recently published by Sivertsen (1954). The present account makes no effort to supplement this paper and mentions only those species personally examined by the writer.

The interorbital region of the frontal bone broadens from a narrow waist at the junction with the cranium to become widest between the supraorbital processes. In *C. ursinus* this region is relatively long and of nearly equal width. The nasals of *A. pusillus* are long and tapering, the anterior width being 60 per cent to 70 per cent of the length. This ratio varies in other species (King, 1954). The Cape fur seal, however, has the longest nasals in the genus *Arctocephalus* (Sivertsen, 1954). The anterior end of the nasal bones is not confluent with but project beyond the premaxillary border. The nasals are blunt behind and do not taper posteriorly as sharply as in *C. ursinus*.

The premaxillary-maxillary suture strikes the nasals at an acute angle about one third of the distance from the anterior end. The palate is cleft posteriorly but this cleft seldom reaches the posterior end of the maxillary process behind the sixth molar. The depth of this palatal notch varies in other species, being shallow in *A. gazella* but deeper in *C. ursinus*. The hamular process of the pterygoid swerves outwards and backwards but not to the same extent as in *C. ursinus*, where it protrudes almost at right angles to the side of the palate. The walls of the pterygoid are very thick, being 55 per cent of the width of the palate below the level of the pterygoid processes but only 35 per cent in the case of *C. ursinus*. The tympanic bulla is large, rugose and somewhat bulbous, the jagged anterior edge being about the same height as the posterior side of the glenoid cavity (Fig. 30, Plate XVI). The inner walls of the bullae tend to bulge inwards but in *C. ursinus*, they are almost parallel. The bullae overlap the carotid canals but this is not the case in either *C. ursinus* or *A. gazella*.

The teeth are often well-worn but powerful, the roots of the lower fangs sinking as much as 50 mm into the lower jaw. The penis bone attains a maximum length of 168 mm in group J and there is little alteration of the bone in later groups. From Fig. 21, Plate IX, it is seen that after the high increases in weight culminating in sexual maturity, there is a drop in incremental growth of the os penis until group F when another rise is recorded concomitant with physical maturity. There is

a similar but lesser increase in length of the bone at this stage. Thereafter both weight and length of the bone drop until growth presumably ceases.

Incremental growth drops steadily in females until group D, any increases then remaining constant until group G when they fluctuate before dropping again to the final group. But the males show a steadying of incremental growth at groups C and D (sexual maturity) and a big secondary increase at group G (physical maturity). Increments then fall until the final male groups.

The seasonal rut is well-defined both in time and place. Bulls come ashore in late October and remain with the cows until the latter are mated (usually by the end of December). No bulls were observed mating outside these months. Histological sections of the testis do not entirely confirm such an abbreviated period of sexual activity and ripe sperm were found in other months, chiefly August. However, no sperm were located in specimens collected during February, March or April, but paucity of adult male material from the autumn and winter prohibits further discussion about the sexual status of the bulls. In Fig. 22, Plate X, weights of testis from summer animals are compared with a few from the winter, and the results point to a short burst of spermatogenic activity during the summer. When further material is obtained male reproductive behaviour will be discussed in another report. During the non-breeding months bulls spend regular periods at sea and on land.

Female.

(a) **Nulliparous Cows (Group D).**

The general characteristics and reproductive behaviour of the nulliparae are described in a previous paper (Rand, 1955 a). These young females belonging to group D have ovulated for the first time. Until properly-aged specimens are obtained the group is considered to range from 20 to 27 months of age. They are difficult to recognise in the field and may easily be confused with the yearlings. Their faded brown coats distinguish them at once in the spring.

The hair coat varies from Dark Olive to a uniform Seal Brown with variations such as Olive Drab, Brownish Olive, and Citrine Drab. The bright yellow strip round the jaws persists in this class. The mean body length is 134·3 cm which is an 11·4 per cent increase over that of the previous summer. Body weights are influenced by the developing embryo and physiological changes associated with pregnancy. Yet weight increments are much less in this than in the preceding group. The skull continues to grow although juvenile characters may be seen in the lack of sagittal crest and only slight nuchal crest. Many sutures of the skull are still open.

(b) **Primiparous Cows (Group E).**

In the summertime members of this group show signs of having been post-partum in only one horn of the uterus. They are identified in this manner. Coat colours are indeterminate, warmer tones affecting the Olive Crab and Dull Citrine of the back of the animal. The abdomen is buffy-brown and the yellow colouration of the jaws much the same as in the preceding groups. It is difficult to recognise the animals on coat colours and general appearance only and certain identification is only possible after autopsy. In the summer the uterus has a single regressing horn, the non-parous one being smooth and relatively small. The presence of only one corpus luteum confirms the uterine diagnosis.

Growth shows no substantial advance over the former group D. Length increases slightly but the percentage increment is less than in group D (Table 10). Weight increments, however, are larger (Table 12). The effect of advancing pregnancy on the rate of growth is difficult to calculate as so few animals were available. One cow in late pregnancy weighed 132 lbs. Others in pro-oestrus averaged 87 lbs with weight fluctuations afterwards as follows:—

105 lb. (December) two specimens; 107 lb. (January) five specimens; 110 lb. (February) three specimens; 96 lb. (March) one specimen. All these animals were pregnant cows with unimplanted embryos.

Skull characters of group E females show a marked advance to adult size and appearance. The interparietal suture is completely closed.

Young cows never seemed to be numerous at the Sinclair Island rookery and in a collection of 175 females from this island (1947–1948) the primiparae formed about 11·3 per cent of the mature cows.

Table 12.

General Data about Female Suture Groups.

Group.	BODY MEASUREMENTS.						SKULL MEASUREMENTS.											
	Length (cm).			Weight (lb.).			Total Length (mm).			Total Weight (gm).			Zygomatic Width (mm).			Hamulo-Premaxilla Length (mm).		
	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.
A.....	90	79·5	65	27	14	6	151	135	116	100	85	63	86	78	67	87	76	64
B.....	111	102·0	92	62	44	33	170	164	159	138	128	112	95	92	89	104	98	93
C.....	130	120·5	106	81	65	42	190	181	170	222	185	147	108	103	95	117	112	103
D.....	147	134·3	124	118	92	70	200	187	180	283	218	179	118	109	103	129	119	110
E.....	155	142·8	130	132	107	92	203	196	187	283	236	195	117	113	110	131	125	115
F.....	175	152·2	142	154	129	100	214	205	197	300	264	157	124	119	112	142	132	123
G.....	167	155·3	146	174	139	104	217	206	197	329	279	218	126	120	112	141	133	125
H.....	165	162·8	156	173	154	127	214	209	204	322	295	252	126	122	115	138	137	135
J.....	172	162·2	154	214	170	141	226	215	204	394	322	274	136	129	121	156	142	132
K.....	176	161·0	148	209	167	142	222	212	207	388	317	260	136	127	119	146	138	131
L.....	170	161·9	147	268	169	131	226	213	207	475	311	269	145	130	123	151	140	131
M.....	176	160·1	150	205	159	125	224	214	207	394	320	270	137	133	121	148	140	131

(c) **Multiparous Cows (Groups F to M).**

Mature cows are a permanent feature of the seal rocks. Gestation is nearly twelve months and the respite after pupping is brief (five days) so that the old females are almost permanently lactating unless the litter dies. Care of the pup makes it imperative that they be at the rookery throughout the year. The unique behaviour of the bull during the breeding season imposes further restrictions on the movements and behaviour of the cows. During the pupping season the cows form aggregations or " harems ", the size and situation of which have an important bearing on management. On undisturbed rocks, cows have a regular routine of movements to and from the sea and they seldom stay away from their pups more than seven or ten days on any one occasion. Four or five days are spent suckling the pup when the cow is at the rookery.

Old cows are large animals reaching a length of nearly six feet and a weight of over 250 lb. in certain instances. Fig. 23, Plate X, shows the rather uniform increases in weight (the averages for weights of nulliparae and multiparae are given in the figure), which is free from the erratic changes shown by the big males. The developing embryo causes the weight of pregnant cows to rise steeply just before parturition but the increment is not as spectacular as the physiological changes accompanying the deposition of blubber in the breeding bulls.

Adult cows are rather drab in colour and lack the physique and heaviness of skull that typify their male counterparts (Figs. 27 and 28, Plates XIV and XV). Nevertheless certain cows may outwardly resemble senile bulls with whom they consort during the winter (non-breeding) months. General body and skull dimensions given in Figs. 16 and 23, Plates VIII and X, illustrate the growth of the cows.

7. Moult.

Most pinnipedes have a coarse outer coat of long hair and an undercoat of fur variously developed or even absent in the different species. The body-covering has properties connected with insulation against cold. When it is absent there is often only a subcutaneous layer of blubber that has somewhat similar functions. However, blubber does not replace a fur or hair pelt although it is somewhat thicker in animals without the fur or hair pelt. In addition the coat facilitates passage through the water, progress over slippery rocks and is a protective covering under a variety of circumstances. The renewal of the coat is closely connected with the special habits and environment of the particular species. Elephant seals which have no thick protective coat when adult, slough off layers of skin while lying in furrow-like wallows smeared with mud. A plentiful supply of blubber enables these phocids, at this stage freed from domestic responsibilities, to retreat to the land for two or three weeks without food. Fur seals on the other hand, when moulting, do not interrupt their movements to and from the sea and the moult is less drastic but equally effective.

All phocids are without underfur but many otariid species have a dense pile beneath the outer or guard hair. Sea lions, for instance, are hair seals that lack the second underlying coat that identifies the fur seals of commerce. Of interest is the Australian fur seal *Neophoca cinerea*, which sheds its underfur at an early age and does not regain this coat (Jones, 1925). The thick fur of the young fur seals is exposed by removal of the outer guard hair and the processed pelts give the high class " sealskins " of commerce. The condition of the fur is important to the fur seal peltry and sealers seek the animals during a short season when the skins are prime and not in moult. The moult interferes with hair removal during processing and affects the quality of the pelt.

Several phocids lose their pup hair before birth; the elephant seals, however, retain the black pelage for some days. Mohr (1952) correlates the prenatal moulting with the biological need to enter the water immediately after birth. Otariids with their long period of childhood on land, do not cast the pup hair until they are some months old.

The Cape fur seal completely renews its outer coat each year in the late summer. By this time the hair is faded and its gradual loss gives the seals a variegated appearance. In spite of its profound importance in commerce, the development of the fur has received little attention. Shedding of the underfur was never detected in *A. pusillus* except as an incidental loss during scratching. In *C. ursinus*, however, there is no agreement about the condition of the fur during the annual moult of the outer coat. Allen (1880) quotes two conflicting views about the replacement of the underfur and subsequent accounts of the biology of this species do not settle this moot point. *C. ursinus* moults in August and September (the northern autumn) some two months after the breeding season. On Marion Island, *A. gazella* replaces its

coat in the late summer from February to April, the moult coinciding with that of *A. pusillus*. *Otaria byronia*, the sea lion of the Falkland Islands, is said to moult over a rather longer period, from April to August (Hamilton, 1934).

The progress of the moult in the Cape fur seal was first studied by making regular inspections of the hair of specimens collected at the same rookery (Sinclair Island) throughout the warm months of the year. During marking it was usual to examine live animals for signs of the moult, data being taken only from those identified with certainty as belonging to a particular age class. These data were supplemented by direct observation of other animals at the same rookery. Branded individuals were of great value in this respect as they gave continuous results about the length of the moult. The moult was calculated as a visible moult only, being timed from the appearance of new hairs until the complete disappearance of the old coat. That the underfur is not lost at the same time as the guard-hairs, was determined by examining specimens that had lost hair in patches round the throat or other parts of the body as a result of fighting or play, or by pulling the hair and fur of "stagey" animals. Nevertheless the whole problem of fur development is one which requires further study.

(i) Moult in the Black Pup.

Cape fur seal pups are born with a dense black coat which is carried for nearly four months. At the start of February there are few signs of hair loss but this commences by the end of that month (Fig. 31, Plate XVII). The visible moult is most widespread during March and April. The percentage of animals with new coats increases during April. Unfortunately no observations were made during the next two months but by July all pups had acquired the thick yearling coat.

Data from marked pups show that the moult starts from 60 to 65 days after birth (Table 13). However, this change is not visible until the third month when the pup has a decidedly yellow face and the new hair gives it a "puffed up" appearance. The time taken to acquire the new coat completely is not known accurately although observations suggest four to five weeks. In the Weddell seal, *Leptonychotes weddelli*, the average duration of the moult is 30·2 days (Bertram, 1940). One Cape fur seal pup was moulting on 25th March and had not entirely renewed its coat by 20th April, some twenty-eight days later.

TABLE 13.

ONSET OF THE MOULT IN MARKED PUPS.

Date	Serial no.	Age.	Remarks.
		Days.	
2 February	652	56	No new hairs visible.
8 February	652	63	No new hairs visible.
2 February	636	65	New hairs on dorsal surface.
2 February	646	66	New hair on head and neck.
8 February	640	70	New hairs on dorsal surface.
11 February	641	72	New hairs on dorsal surface.
11 February	617	81	New hairs on dorsal surface.
8 February	598	84	New hair over whole body.

The Cape fur seal pup moults unobtrusively. White-tipped hairs are first seen at the base of the nose, later round the jaws. They then appear on the crown of the head and upper surface of the body. The new coat is dark at first with a decided yellowing round the jaws, base of the tail and ears. The underfur thickens and becomes buffy-brown in colour. Mohr (1950) claims that all the facial hairs moult in seals, but no evidence of this was found in *A. pusillus* where the vibrissae are considered to persist throughout life.

(ii) Moult in the Yearling.

First-year animals moult at the age of fifteen months, or some twelve months after they shed their black pup coats. Owing to the possibility of error in separating first and second-years in midsummer, the coat changes were only calculated from marked animals and specimen records. In Fig. 32, Plate XVII, the moult is expressed as a percentage of moulting to non-moulting animals as follows: in the figure clear rectangles are non-moulting animals, black depict moulting and hatched have finished moulting. Observations between December, 1948 and February, 1949 showed that yearlings moult between these months. It is possible that the moult extends to March but visits to Seal Island (False Bay) during the autumn showed that the moult was over by April.

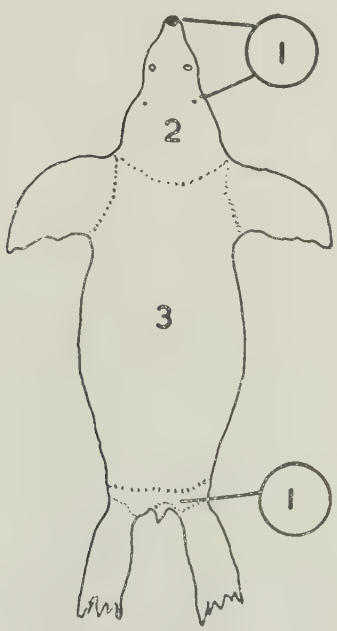
On Sinclair Island handling of marked animals confirmed binocular observations but failed to define the full extent of the moult within the class. The duration of the moult is uncertain but the data in Table 14 show that for three yearlings at least the minimum period was 21 to 23 days. Additional information about the time of the moult in 1947 and 1948 yearlings is given in Fig. 33, Plate XVIII. For some unaccountable reason the yearlings of 1948 moulted somewhat earlier than those of 1947.

TABLE 14.

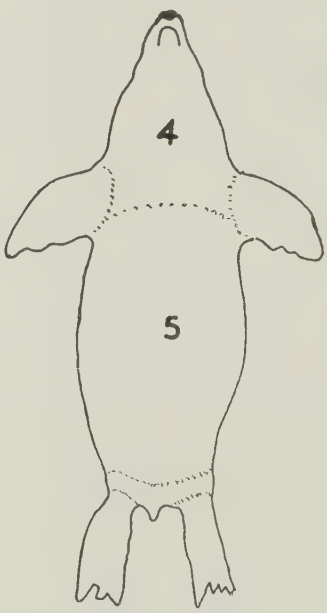
MOULT IN MARKED YEARLINGS.

Brand Mark.	First seen Moulting.	Last seen Moulting.	Duration of the Moult.
II	15 March	—	—
E	8 March	29 March	21 days.
F	17 March	—	—
B	17 March	—	—
I	8 March	—	—
Z	20 March	10 April	21 days.
P	4 April	—	—
K	—	20 April	—
24	21 March	13 April	23 days.

SEQUENCE OF VISIBLE MOULT.



DORSAL.



VENTRAL.

The first signs of moulting in the yearling are white hairs round the base of the nose, ears and tail. Replacement of the old hair is gradual and there is no sudden sloughing off of patches of hair as may be seen in the elephant seal. Incipient moulting is more frequently seen in the male fur seals where old hair disappears from the chest and the axillae of the flippers as a result of fighting or play. Brown patches of fur remain on these spots.

The new coat is uniformly Silver Gray on the back and on the belly; in some cases it may vary from shades of Hathi Green to Grayish Olive. The axillae are darker than the normal Seal Brown colour of the autumn and the yellow patch round the jaw is brighter. These colours soon fade, the dorsal surface becoming darker, the ventral lighter (Olive Buff to Grayish Olive).

Pelts from moulting animals are called " stagey ", the emerging hairs giving them the appearance of a " blue skin ". Both these terms are used in the fur trade. Yearlings caught in late April or May are unlikely to be stagey but their pelts do not have a prime fur. Those caught after October but before January are unlikely to show " staginess " but the condition of the fur may not be as good as that of the mid-winter pelts. The interim period, June to September, is used for sealing operations. Many years ago these operations were conducted as early as May and as late as October. Yearlings from the summer months of November and part of December have occasionally been included among catches of adult pelts. It is possible but rather unlikely that these pelts may show incipient staginess. Reports of stagey skins among the winter catches, however, pose unexplained problems about factors that induce the moult.

(iii) Moult in the Second-year.

The yearling coat is replaced after ten months. Nine marked yearlings moulted in 1948 and again in 1949 as second-years. The average time between these moults was nine months and twenty-one days. The start and duration of the moult is some animals is given in Table 15, which shows an estimated duration of about twenty-days for the moult. Data in Table 15 are again illustrated in Fig. 34, Plate XVIII. The graph illustrates the limitations imposed on observations of animals that move freely between land and sea, for many animals were absent at different times of the moult and this could not be calculated completely. Six branded animals were watched regularly during December, January and part of February. The days on which new hair was noted are shown in black in Fig. 34, Plate XVIII. The moult was frequently detected for the first time only when the new hair was visible. Periods when the young animals were ashore are cross-hatched in this figure. Certain animals such as " ♀ " spent more time ashore than others such as " 17 " or "E ", and these gave more accurate data about the moult than the others. From Table 15 and Fig. 34, it is apparent that most second-years finish moulting by the end of February.

TABLE 15.

MOULT IN SECOND-YEARS.

Number or Mark.	First seen Moulting.	Last seen Moulting.	Estimated Duration of Moult.
			Days.
207	25 January	15 February	30
631	12 January	18 February	37
136	7 January	26 January	19
17	30 December	12 January	13
15	9 January	25 January	16
13	28 January	15 February	18
11	28 December	9 January	12
E	4 January	3 February	30
N	9 January	26 January	17
B	23 January	8 February	17
I	5 January	19 January	14
C	18 December	19 January	32
F	3 January	25 January	22
P	2 January	26 January	23

(iv) Moult in Adults.

Many adults are visibly moulting in the late summer (January till March). A few start losing their old hair in December. The percentage of moulting and non-moulting adults among specimens examined from August till April is given in Fig. 35, Plate XIX. Signs of the moult are less pronounced in the bulls than in the cows. The latter are very mottled at this stage, the hair disappearing in patches from the head and from the axillae of the flippers and leaving a pattern of yellow, grey and brown colours. The new coat of the cow is usually a Neutral Gray, turning more buff-coloured later. In young bulls the new hair darkens after the moult but the older males regain the drab grizzliness of their previous coats. The moult in adult *C. ursinus* is said to take 42 days (Allen, 1880). It could not be calculated for the adult Cape fur seal.

(v) Moult in Unseasonal Pups.

A few Black Pups are born during the winter. Three of these black pups were discovered on Sinclair Island in August 1947 when they were a few weeks old. Two of them were immediately marked and their movements noted for over two years afterwards. The case-history of pup "T" showed that it lost its black coat in November 1947 but did not moult again until February 1949, seventeen months after the first moult and at an estimated age of 20 months. Pup "L" was not observed shedding its pup coat but in November 1948 lost its yearling coat after an early summer moult. Both these marked pups moulted as yearlings in the summer when they were about twenty months old instead of the usual sixteen months. The moult in these circumstances appeared to be correlated with climatic rather than physiological conditions.

8. MORTALITY.

The Cape fur seal is a hardy animal. If undisturbed, it breeds rapidly and successfully. Rookeries that have been untouched by sealers for some years soon become overcrowded and the herd may overflow onto nearby rocks or the adjacent mainland. Man makes the greatest inroads into its numbers both by organized operations or by invidious attacks on isolated animals that are encountered in his fishing grounds. Indeed, the scattered and illegal killing of seals by fisherman constitutes a threat to proper management and controlled slaughter of the animals, and confuses calculations of natural mortality at sea. It is a form of pelagic sealing without the advantages of control or rational use.

(a) Natural Enemies.

Fur seals have few enemies except sharks and killer whales. Land carnivores may prey on young pups washed onto the deserted coast but have failed to prevent the spread of seals to the mainland. In the vicinity of the rookeries, man-eater sharks (*Carcharodon*) often kill young seals when these are supposedly asleep on the surface or weakened through disease or previous wounds. The type of laceration inflicted on the seal appears to show that the attack is a surprise one. In the deep sea (trawling grounds) seals may be observed swimming beside sharks, both feeding off discarded fish from the trawl nets. Injuries from the shark bites may be fatal but severe wounds have healed after a long stay ashore.

An unconfirmed report suggests that killer whales (*Orca*) make heavy but infrequent raids on seals feeding far out at sea.

(b) Parasites.

Adult seals may be heavily infested with internal parasites, the young animals to a lesser degree. Arachnid parasites occur in most animals. They have been identified as *Orthohalarachne attenuata* (Banks) from the nasal cavity, and *Orthohalarachne diminuata* (Doetschman) from the pulmonary tubes (Till, 1955). In addition to the above mites, Zumpt (private communication) found a new species of louse (*Proechinophthirius*) as common ectoparasites of fur seals on Seal Island (Mossel Bay). The lice were not visible to the naked eye.

Nematodes (*Contracaecum osculatum*) are commonly found in the stomach. The intestine harbours a cestode *Diphyllobothrium arctocephalium* and an acanthocephalian *Corynosoma australe*. Larval cestodes are frequently found embedded in the abdominal blubber and have been provisionally identified as a tetraphyllid species *Phyllobothrium* (Ortlepp, private communication). It is not known if these parasites have proved fatal to the seals.

(c) Disease.

Diseased animals were seldom encountered at the rookeries. Decrepit or wounded seals are known to haul out to special parts of the rookery where they can convalesce without interference from the breeding herd. Disease of the liver (*necrotic hepatitis*) was noted in one specimen but most pathological cases involved the genitalia. In the male, inflammation of the penis and scrotum frequently followed lacerations inflicted during territorial fighting. The os penis was sometimes broken. In the female, injury to the genital tract sometimes resulted in partial or complete sterility or even death. Follicular cysts and disorganisation of the uterus (*prolapsus*) were common functional disturbances seen during the summer. Severe cases of *prolapsus* resulting in evisceration of the animal followed disturbance during pupping. Mechanical injury to the evaginated uterus was particularly severe when cows were forced to flee down jagged rocks.

(d) Fighting.

Fighting only emanates from territorial disputes which occur in the summer. The bickering and petty squabbles of over-crowded animals are composed of a repertoire of threats and lunges but subside without serious results during the non-

breeding months. Normally the establishment of territories takes place with little fighting, the dominance of particular males depending upon physical appearance and threats rather than overt physical violence. Conditions change when sealing operations interfere with the normal pattern of dominance in a summer herd and desperate battles ensue between animals returning to their old stations among the cows. Bulls occasionally perish during severe skirmishes or as a result of wounds received. Cows may fight bitterly over pups but the bull prevents serious quarrels in his harem. After the birth of the pups, territorialism relaxes and the disintegration of the herd dissolves problems of overcrowding and behaviour which had previously resulted in fighting.

Fighting and the disturbance it creates among the packed animals has far-reaching results upon the welfare of the new-born pups. Normally it never reaches serious proportions, but under the stress of sealing it may unsettle the stability of the herd to an undesirable degree.

(e) Depredations of Man.

Sealing operations during the winter account for about 30,000 yearlings of both sexes. About 6,000 bulls are killed on certain rookeries during the summer. Owing to the limited size of the island rookeries, deployment of the sealing teams is difficult and the division between idle (surplus) bulls and harem bulls is not always evident. Although the sealers aim at the idle bulls, their operations frequently impinge upon the harem groups. Stampeding animals crush or otherwise kill the pups by causing them to fall from ledges, stray from the birthplaces and succumb to hunger or even perish during disputes between cows for ownership of the pups. Owing to these considerations, summer operations have gradually diminished, the tendency being to concentrate on organised operations in the winter and spring.

9. ACKNOWLEDGEMENT.

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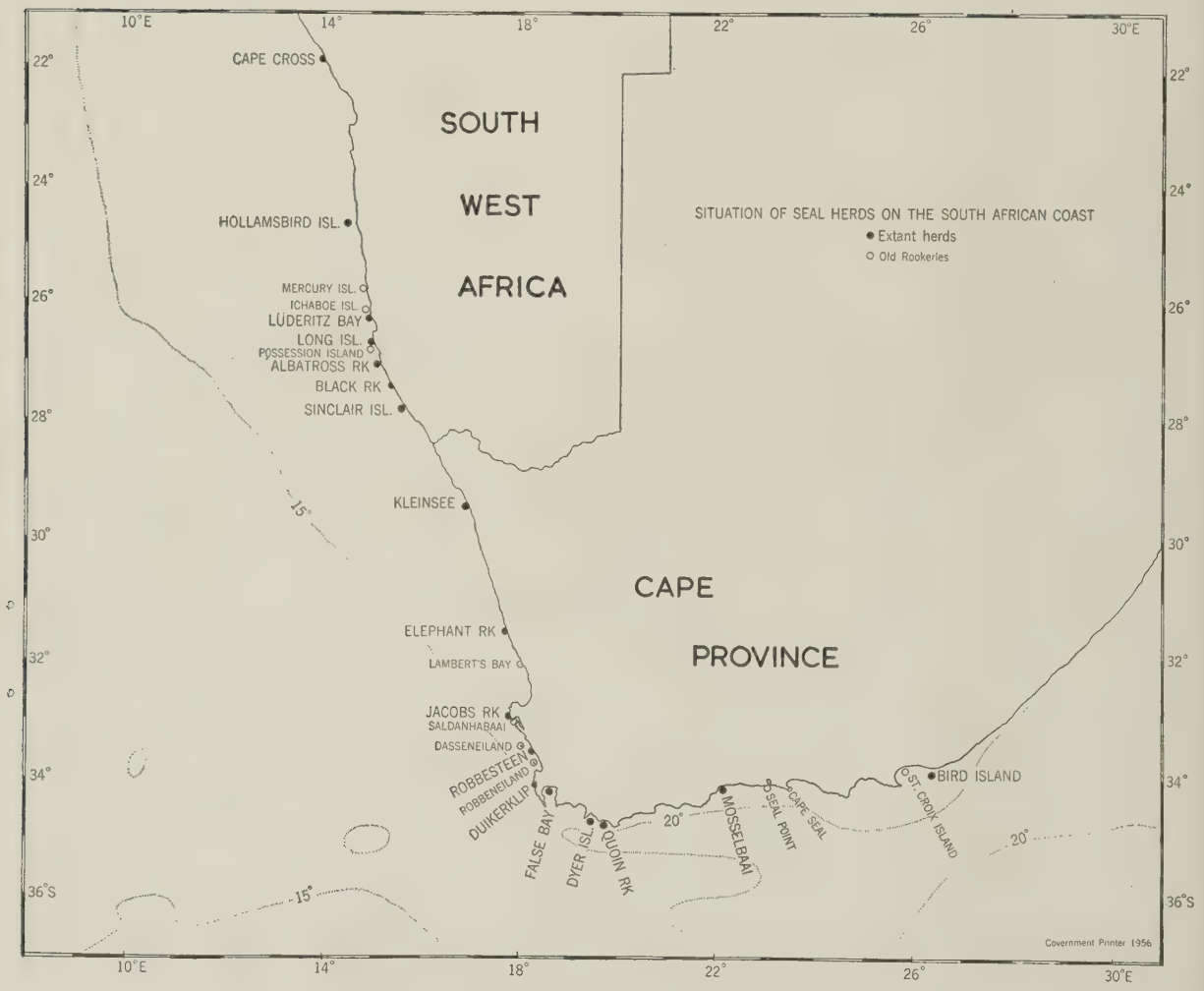
PLATE I



Situation of seal herds on the South African coast.

PLATE II

Breeding range of various southern fur seals. [Adapted partly from Sivertsen (1954) and King (1954)].

PLATE III

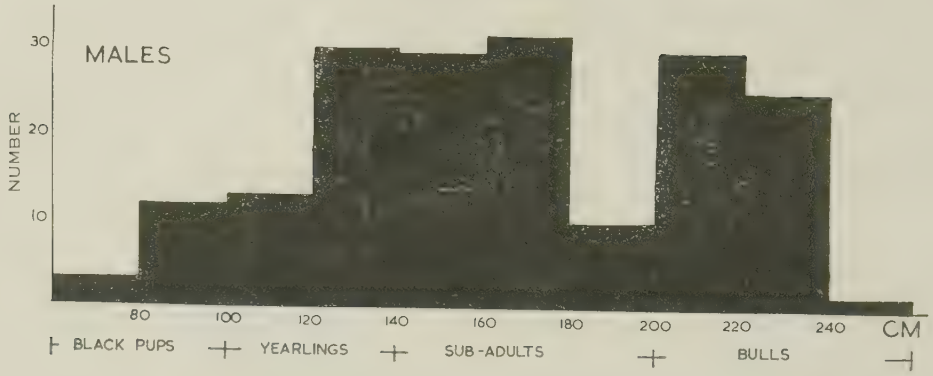


FIG. 1 BODY LENGTH FREQUENCIES OF MALES

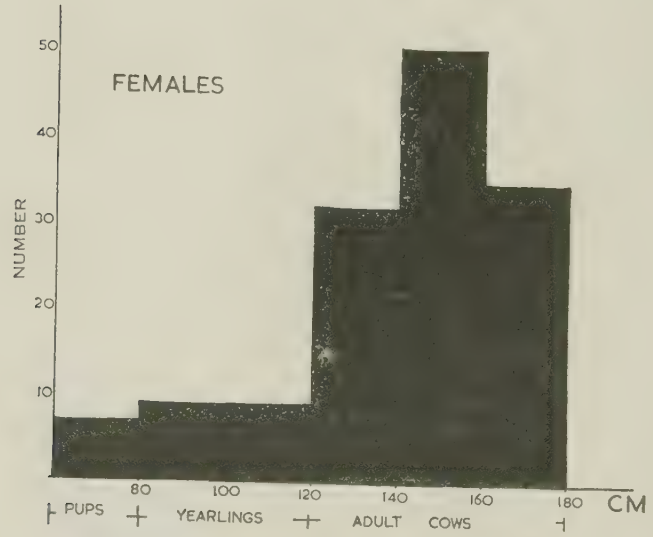


FIG. 2 BODY LENGTH FREQUENCIES OF FEMALES

FIG. 3 TESTIS WEIGHT FREQUENCIES

PLATE IV

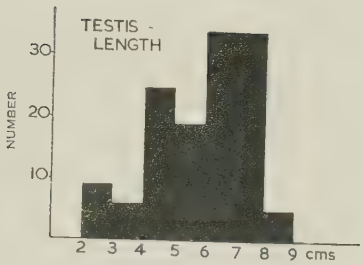


FIG. 4 TESTIS LENGTH

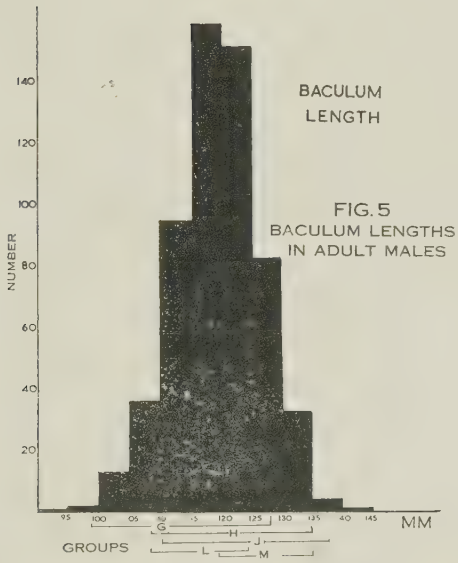


FIG. 5
BACULUM LENGTHS
IN ADULT MALES

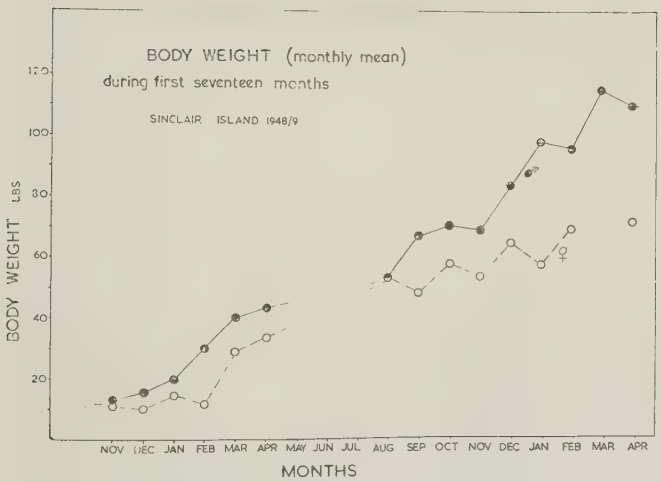


FIG. 6 BODY WEIGHT OF YOUNG SEALS

PLATE V

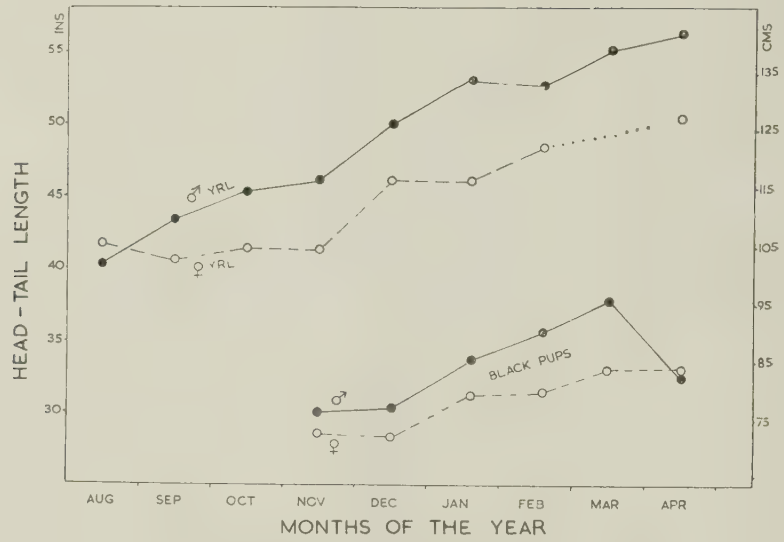


FIG. 7 BODY LENGTHS OF PUPS AND YEARLINGS (SPRING TO AUTUMN)

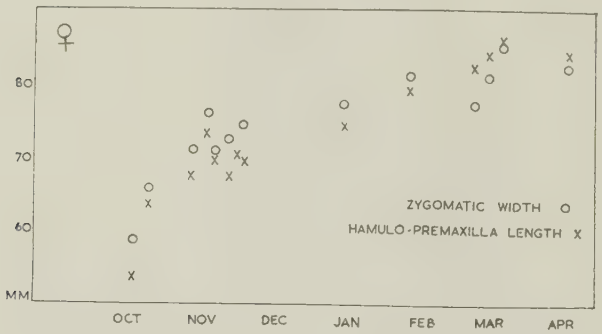


FIG. 8 CHANGE IN SKULL DIMENSIONS OF FEMALE PUPS

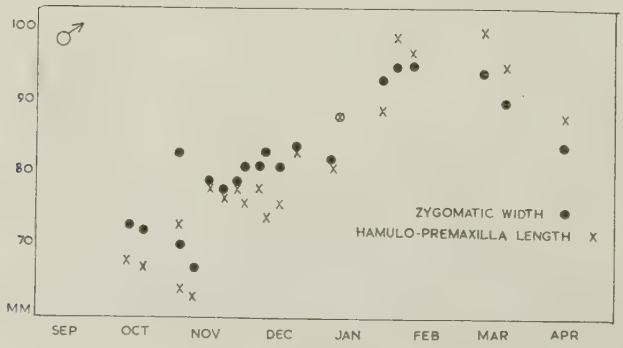


FIG. 9 CHANGE IN SKULL DIMENSIONS OF MALE PUPS

PLATE VI

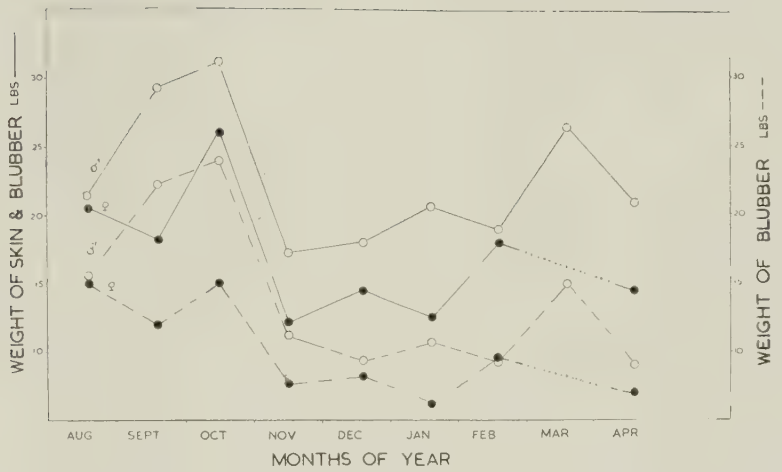


FIG.10 CHANGE IN BLUBBER WEIGHTS OF YEARLINGS

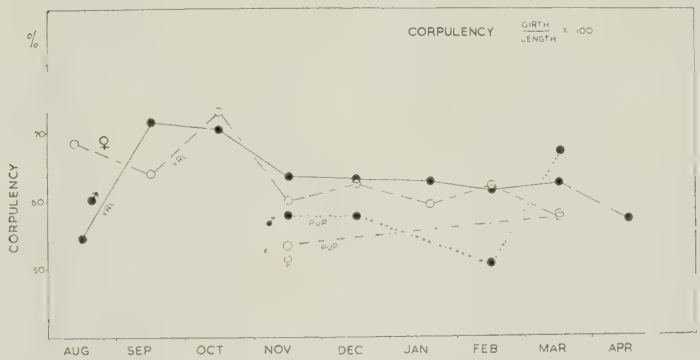


FIG.11 CORPULENCY OF PUPS AND YEARLINGS

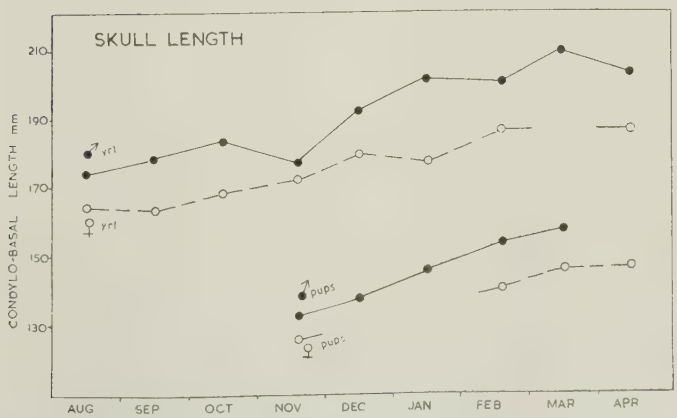


FIG.12 SKULL LENGTH OF PUPS AND YEARLINGS

PLATE VII

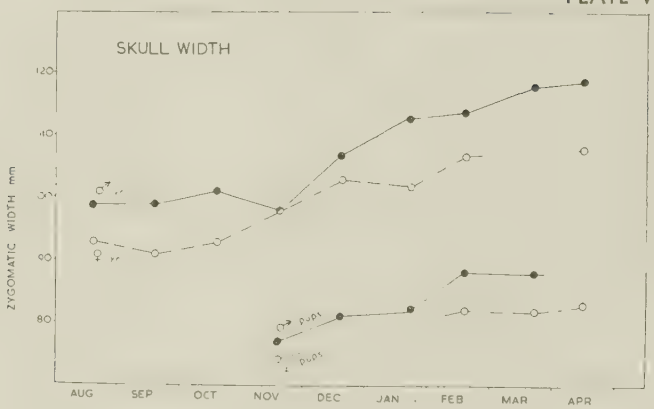


FIG.13 SKULL WIDTH OF PUPS AND YEARLINGS

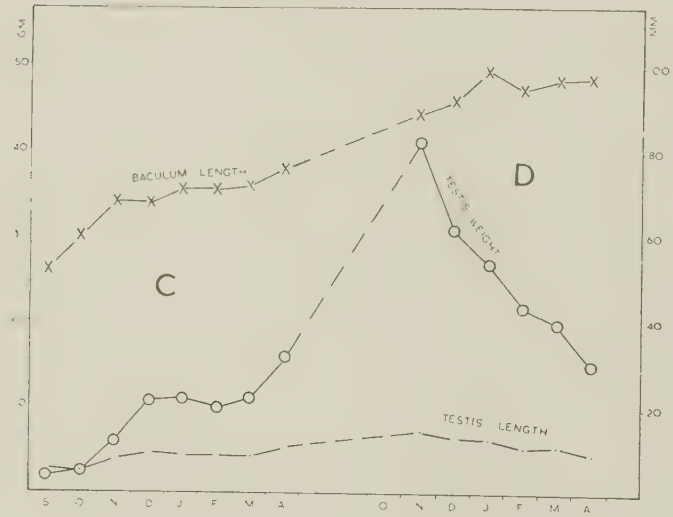


FIG.14 BACULUM AND TESTIS DIMENSIONS (MONTHLY AVERAGE) IN GROUP C AND D MALES

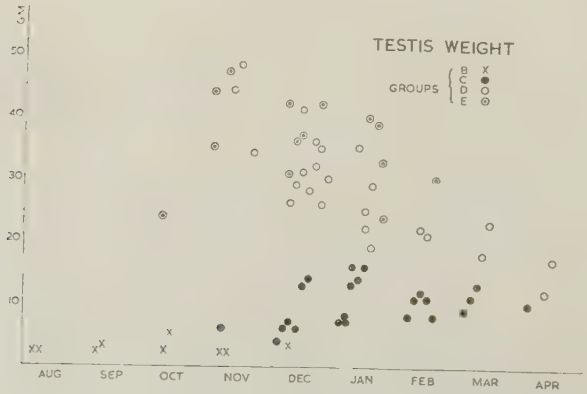


FIG.15 TESTIS WEIGHT IN SUB-ADULT MALES

PLATE VIII

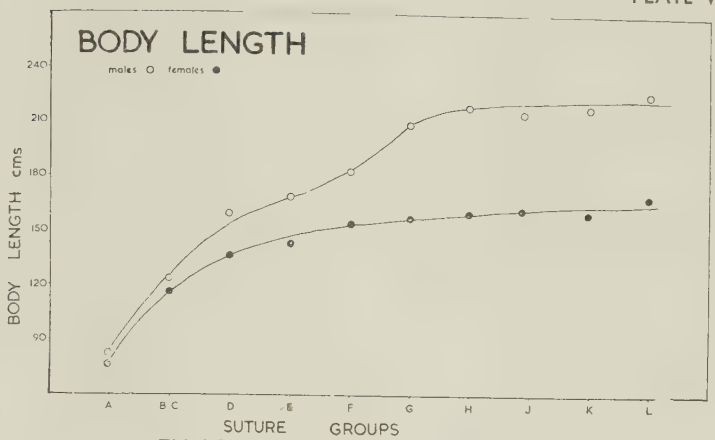


FIG.16 INCREASE IN BODY LENGTH

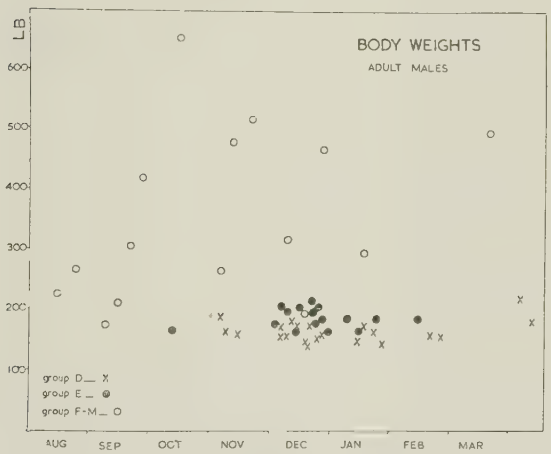


FIG.17 BODY WEIGHT OF ADULT MALES

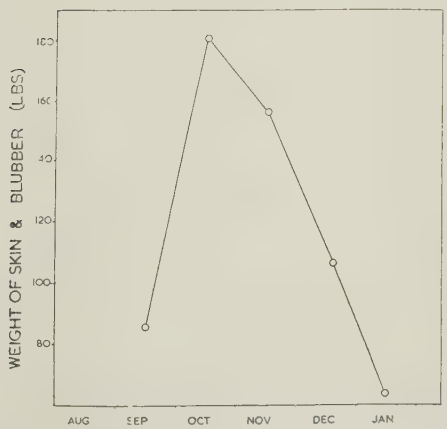


FIG 18 AVERAGE WEIGHT OF SKIN AND BLUBBER OF BULLS

PLATE IX

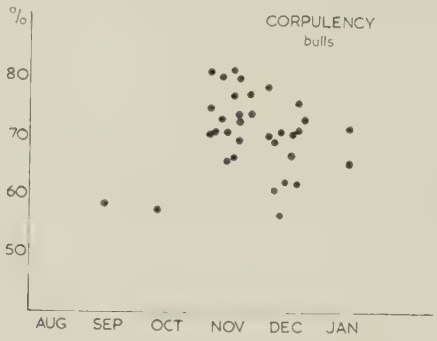


FIG. 19 CORPULENCY IN BULLS

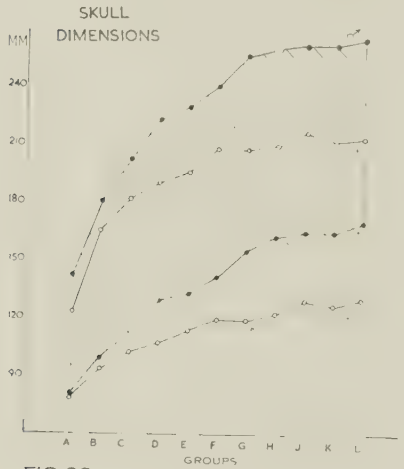


FIG. 20 SKULL DIMENSIONS OF ADULTS

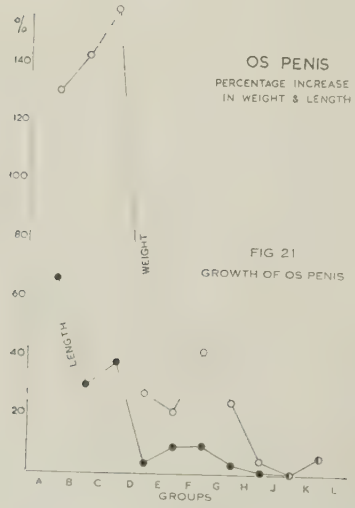


FIG 21
GROWTH OF OS PENIS

PLATE X

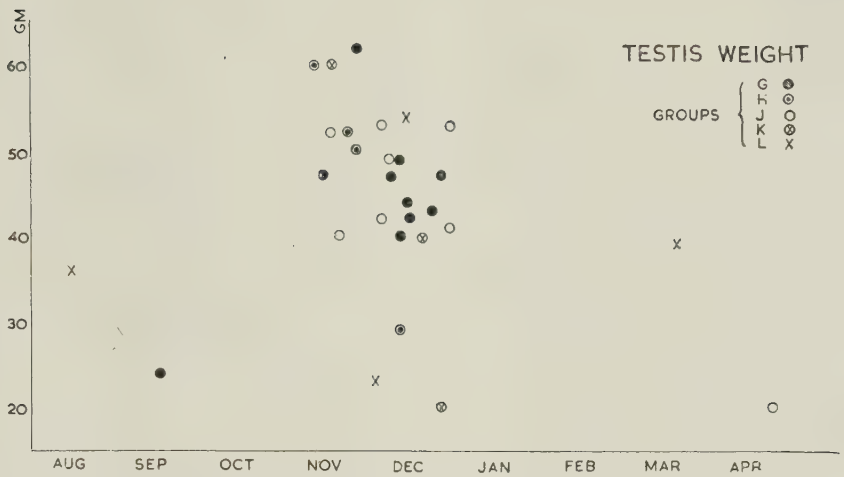


FIG. 22 AVERAGE TESTIS WEIGHT

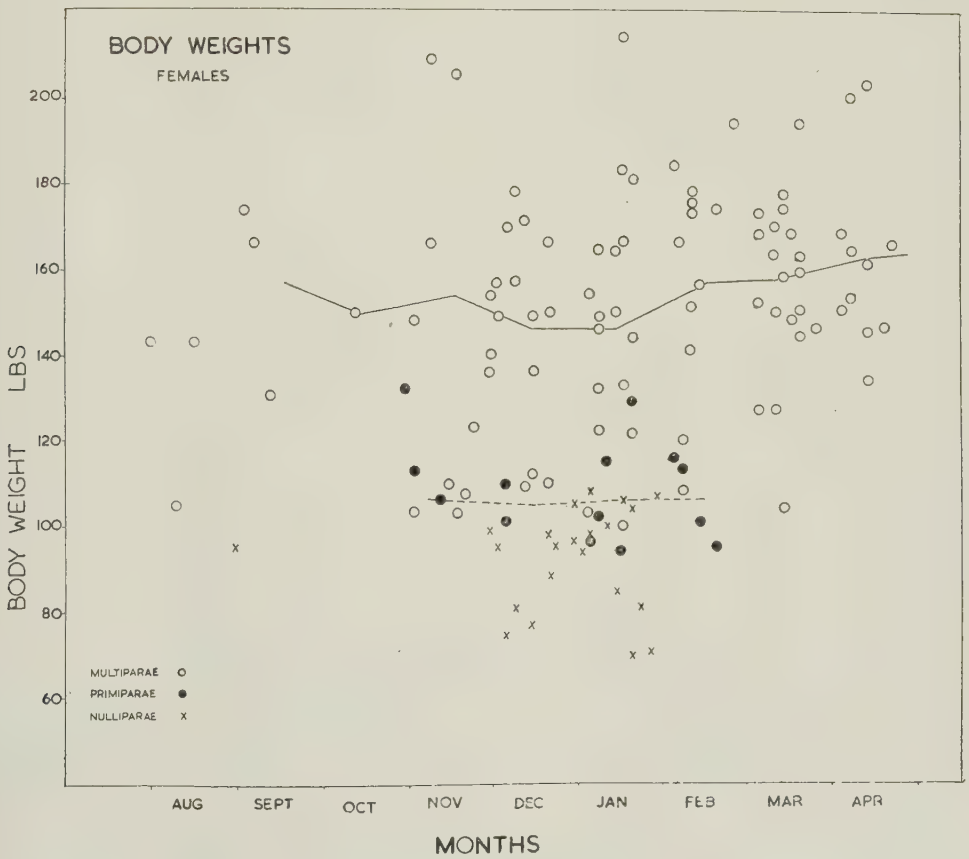


FIG. 23 BODY WEIGHTS OF ADULT FEMALES

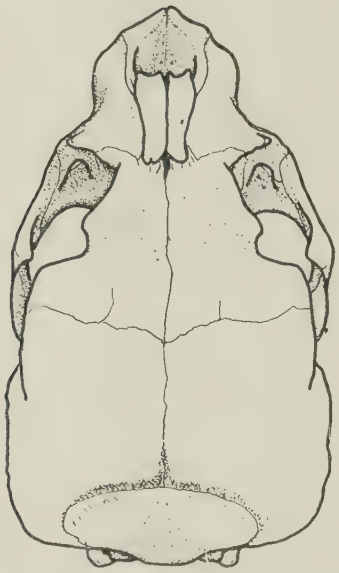


FIG. 24A.—Dorsal view.

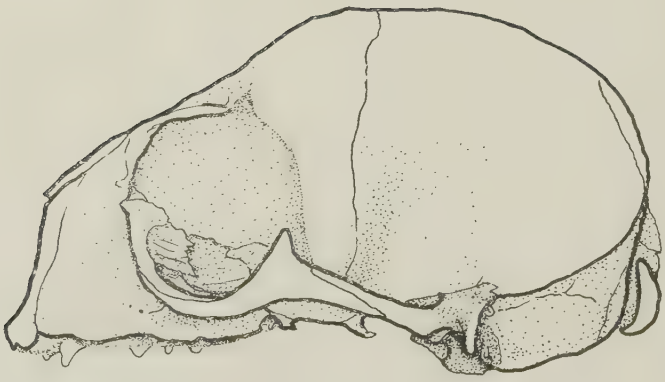


FIG. 24B.—Side view.

Skull of male Black Pup (No. 2938).

PLATE XII

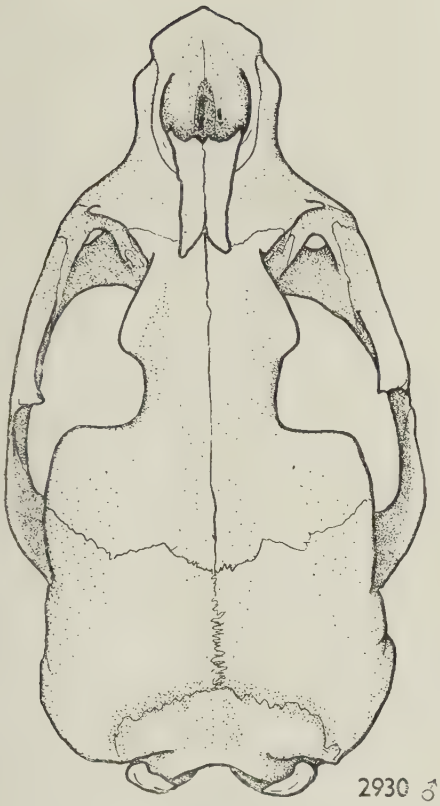


FIG. 25A.—Dorsal view.

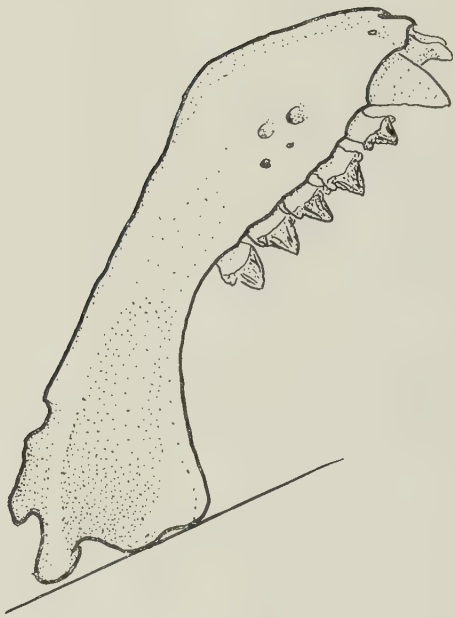


FIG. 25C.—Lower jaw.

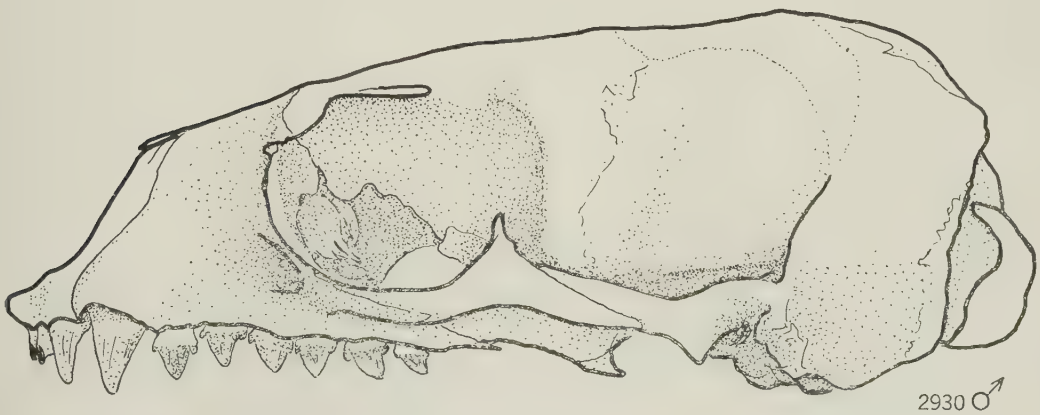


FIG. 25B.—Side view.

Skull of male yearling (No. 2930).

PLATE XIII

FIG. 26A.—Dorsal view.

FIG. 26D.—Lower jaw—end view.

FIG. 26C.—Lower jaw—side view.

FIG. 26B.—Side view.

Skull of group Female (No. 2925).

PLATE XIV

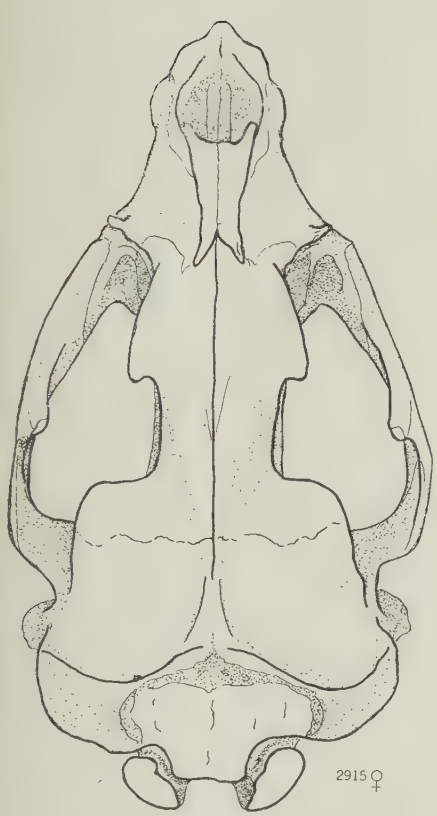


FIG. 27A.—Dorsal view.

FIG. 27C.—Lower jaw—end view.

FIG. 27D.—Lower jaw—side view.

FIG. 27B.—Side view.

Skull of group F female (No. 2915).

PLATE XV

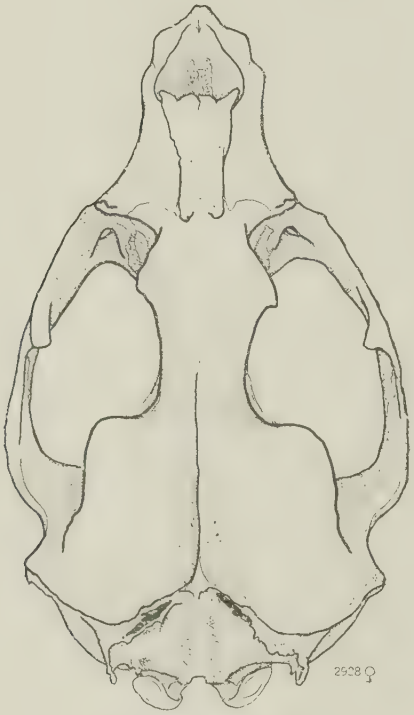


FIG. 28A.—Dorsal view.

FIG. 28B.—Side view.

Skull of group M female (No. 2928).

PLATE XVI

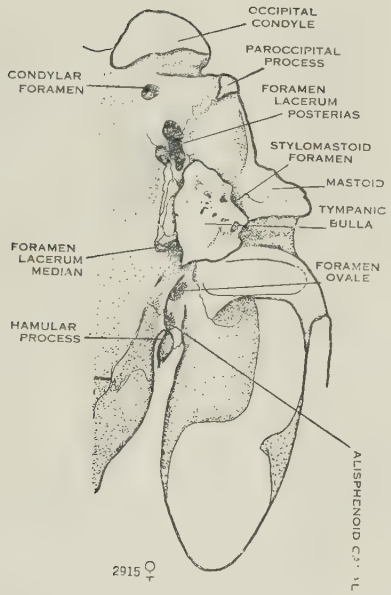


FIG. 29.—Tympanic bulla of adult female.

FIG. 30.—Tympanic bulla of adult male.

PLATE XVII

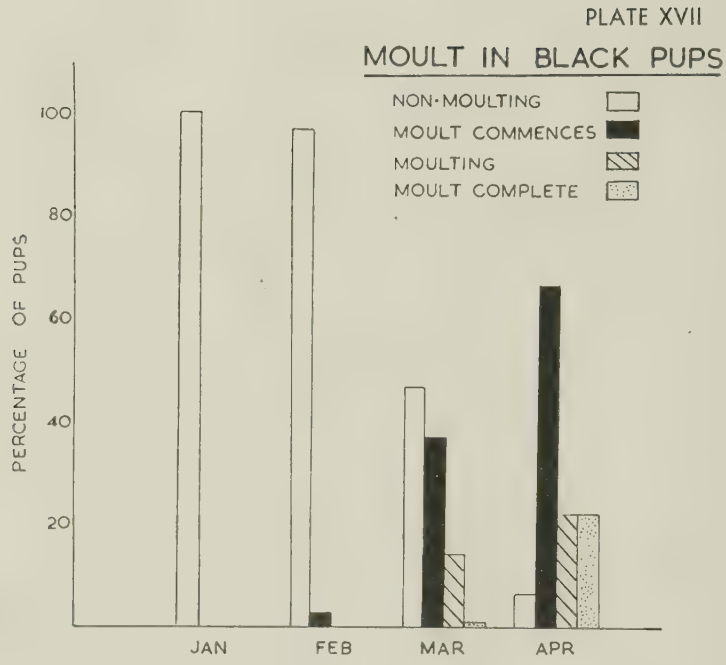


FIG. 31 MOULT IN BLACK PUPS

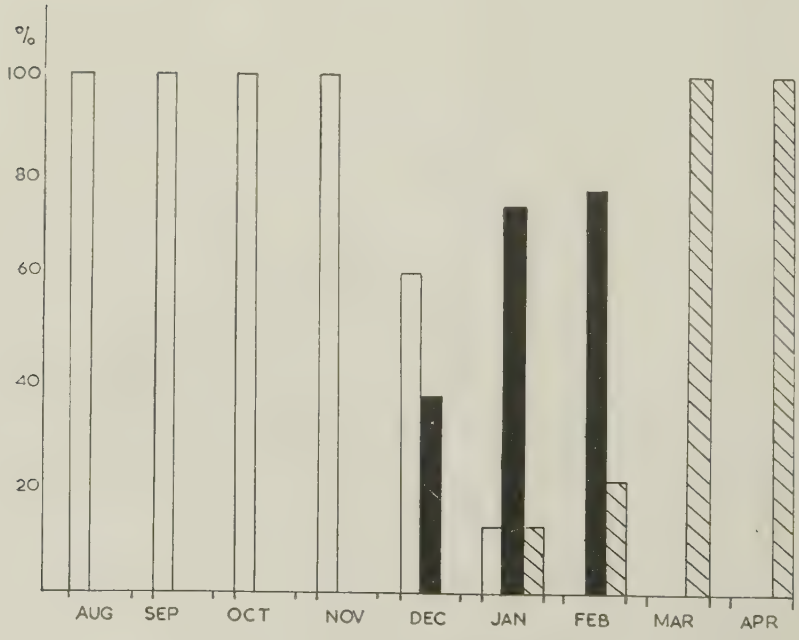


FIG. 32 MOULT IN THE YEARLING CLASS

PLATE XVIII

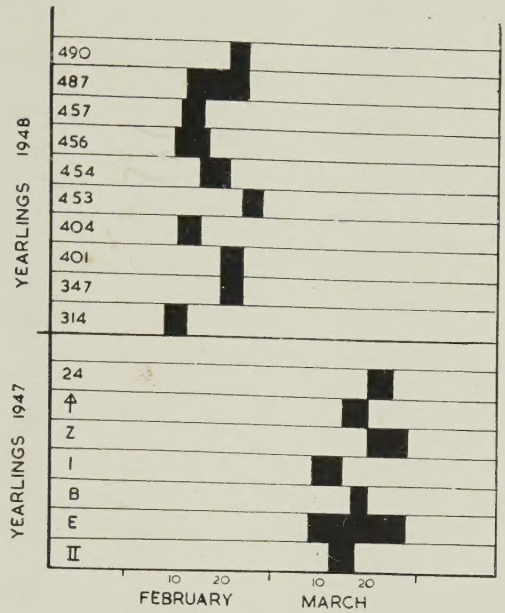


FIG. 33 MOULT IN THE YEARLING CLASS

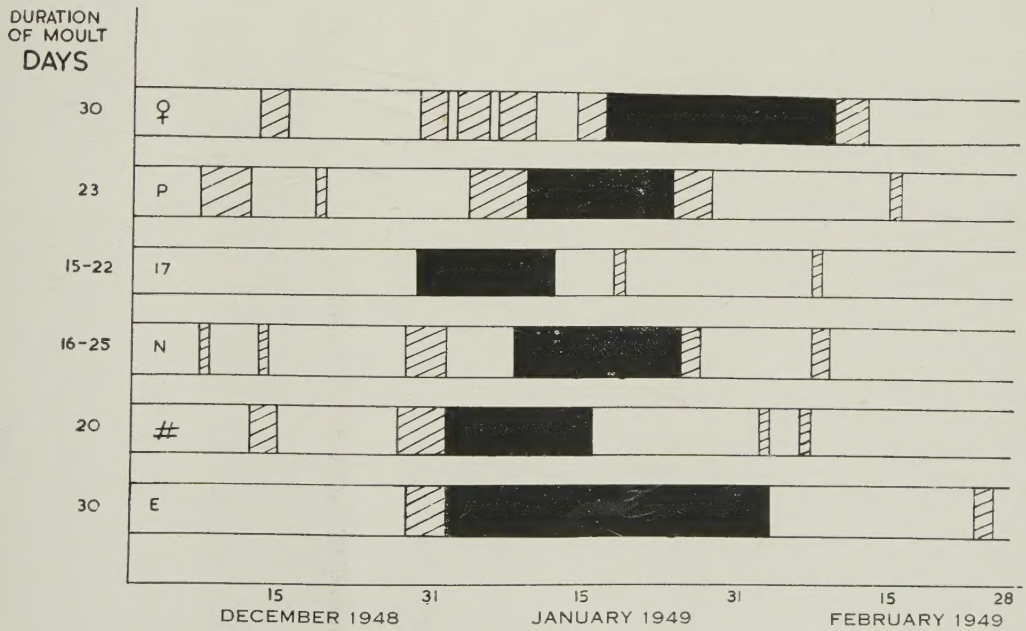


FIG. 34 MOULT IN MARKED SECOND-YEAR SEALS

PLATE XIX

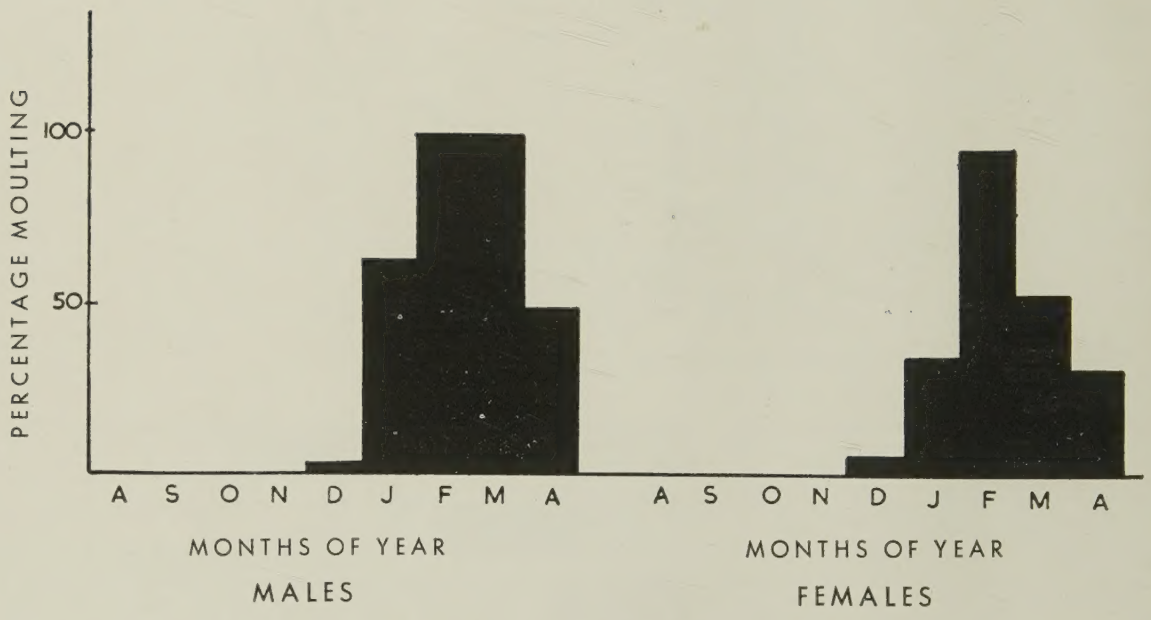


FIG. 35.—Percentage of adults moulting in the summer and autumn.